



CITY OF LEAVENWORTH, WA

CONTRACT DOCUMENTS for

WASTEWATER TREATMENT PLANT IMPROVEMENTS

VOLUME 1 OF 3
Bid Documents
General Requirements
Divisions 1 - 25

Funded By:
USDA - Rural Development

DECEMBER 2019

VA VARELA & ASSOCIATES, INC.
ENGINEERING AND MANAGEMENT
PLANNING • DESIGN • MANAGEMENT • INSPECTION

ESVELT
ENVIRONMENTAL
ENGINEERING

CITY OF LEAVENWORTH, WA

CONTRACT DOCUMENTS for

WASTEWATER TREATMENT PLANT IMPROVEMENTS

CITY OFFICIALS:

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CITY ADMINISTRATOR

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Clint Strand

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***VOLUME 1 of 4
Bid Documents
General Requirements
Divisions 1 - 25***



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**ADVERTISEMENT FOR BIDS
CITY OF LEAVENWORTH
WASTEWATER TREATMENT PLANT IMPROVEMENTS PROJECT**

Separate sealed bids will be received by the City of Leavenworth at the City Hall, located at 700 Highway 2 / PO Box 287, Leavenworth, WA 98826, until 2:00 PM, January 29, 2020, and publicly opened and read aloud at that time.

The CONTRACT DOCUMENTS may be examined at the following locations.

1. City of Leavenworth, 700 Highway 2/PO Box 287, Leavenworth, WA 98826 (509) 548-5275
2. Varela & Associates, Inc., 601 W. Mallon Ave Ste A, Spokane, WA 99201 (509) 328-6066
3. Various plan centers - call Varela & Associates or visit www.varela-engr.com for list.

This work is for construction of improvements to the City of Leavenworth's wastewater treatment plant. Major elements of work include: new tertiary treatment system for phosphorus reduction consisting of new pre-engineered metal building, flocculation tanks, disc filters, and associated site and electrical improvements; equipment replacements including headworks screening system, clarifier mechanism, centrifuge sludge dewatering system, in-vessel UV system; electrical and controls upgrades; process piping, earthwork, site improvements, and associated work. See Contract Documents for project requirements and specifications.

The project is located within the City of Leavenworth city limits, rights-of-way and easements. See Bidders Qualifications requirements in the Bid Documents.

A nonmandatory PREBID CONFERENCE is scheduled for 10:30AM on January 9th, 2020 at City of Leavenworth City Hall followed by a site visit. The purpose of the conference is to familiarize prospective bidders with the project and answer questions.

Proposals must be submitted on the forms provided in the Contract Documents. Bid bonds in an amount not less than 5% of the amount bid are to be made payable to the City of Leavenworth. 100% performance and payment bonds will be required from the successful bidder.

The City of Leavenworth is an equal opportunity and affirmative action employer. Disadvantaged, tribal-, minority- and women-owned businesses are encouraged to submit bids. All work performed on this project will be subject to prevailing state wage rates. The project is funded by a grant/loan from the United States Department of Agriculture Rural Development program.

Section 746 of Title VII of the Consolidated Appropriations Act of 2017 (Division A - Agriculture, Rural Development, Food and Drug Administration, and Related Agencies Appropriations Act, 2017) and subsequent statutes mandating domestic preference applies an American Iron and Steel requirement to this project. All listed iron and steel products used in this project must be produced in the United States. The term "iron and steel products" means the following products made primarily of iron or steel: lined or unlined pipes and fittings, manhole covers and other municipal castings, hydrants, tanks, flanges, pipe clamps and restraints, valves, structural steel, reinforced precast concrete, and construction materials. The de minimis and minor components waiver apply to this contract.

The City of Leavenworth reserves the right to reject any and all bids, to waive technicalities, and in its sole judgement, accept the bid which it deems is in its best interest. Additional bid acceptance and contract award provisions are specified in the Contract Documents.

Copies of the CONTRACT DOCUMENTS may be purchased at the office of Varela & Associates, Inc., here after referred to as the Issuing Agent, for \$100 per set (non-refundable, see address above). For additional information regarding this project, contact Daniel Cowger, P.E., at Varela & Associates, Inc., at (509) 328-6066 or danielc@varela-engr.com.

INSTRUCTION TO BIDDERS

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The Advertisement for Bids lists the State and/or Federal funding agencies partnering to fund this Project. Neither the State of Washington nor any of its departments or employees are, or shall be, party to this Contract or any subcontract.

ARTICLE 1 DEFINED TERMS

1.01 Terms used in these Instructions to Bidders will have the meanings indicated in the General Conditions and Supplementary Conditions. Additional terms used in these Instructions to Bidders have the meanings indicated below:

A. Issuing Office--The office from which the Bidding Documents are to be issued and where the bidding procedures are to be administered.

ARTICLE 2 COPIES OF BIDDING DOCUMENTS

2.01 Complete sets of the Bidding Documents in the number and for the deposit sum, if any, stated in the Advertisement for Bids may be obtained from the Issuing Office. The

deposit will be refunded to each document holder of record who returns a complete set of Bidding Documents in good condition within 30 days after opening of Bids.

- 2.02 Complete sets of Bidding Documents must be used in preparing Bids; neither Owner nor Engineer assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.
- 2.03 Owner and Engineer in making copies of Bidding Documents available on the above terms do so only for the purpose of obtaining Bids for the Work and do not confer a license or grant for any other use.

ARTICLE 3 QUALIFICATIONS OF BIDDERS

- 3.01 To demonstrate Bidder's qualifications to perform the Work, Bidder shall submit with its Bid written evidence establishing its qualifications such as financial data, previous experience, and present commitments, and all items listed herein and in Bidder's Qualification Statement.
- 3.02 A Bidder's failure to submit required qualification information may disqualify Bidder from receiving an award of the Contract.
- 3.03 No requirement in this Article 3 to submit information will prejudice the right of Owner to seek additional pertinent information regarding Bidder's qualifications.
- 3.04 Bidder is advised to carefully review those portions of the Bid Form requiring Bidder's representations and certifications.
- 3.05 Bidder shall have the following minimum qualifications in order to demonstrate that it is qualified to perform the Work and that Bidder is responsible. Bids from Bidders that do not meet the following criteria shall not be accepted.
 - A. Bidder shall be licensed to do business in the State of Washington.
 - B. Bidder shall have adequate bonding capacity for furnishing the required Performance and Payment Bonds.
 - C. Bidder shall have had successfully completed a minimum of one (1) activated sludge mechanical wastewater treatment plant (requiring an operator with a Dept. of Ecology Group III certification) project with a minimum contract amount of \$10 million, completed within the most recent three (3) years from the date of Bid opening.
 - D. Bidder's proposal shall include the assignment of a competent and experienced project superintendent and project manager for the entire duration of the project. The project superintendent and project manager shall be separate individuals with the minimum qualifications specified herein.
 - E. Bidder's proposed project superintendent shall be on Bidder's payroll at the time of Bid Opening; shall have a minimum of twenty (20) years of experience in the supervision of mechanical water or wastewater treatment plant construction projects; and shall have successfully supervised the completion of a minimum of five (5) activated sludge mechanical wastewater treatment plant construction projects as the

- project superintendent. Proposed superintendent's experience including contracting company name, project name, location, initiation and completion dates of the contract, and project owner or engineer reference name and phone number shall be submitted for verification of this requirement and attached to the Qualifications Statement.
- F. Bidder's proposed project manager shall be on Bidder's payroll at the time of Bid Opening; shall have a minimum of fifteen (15) years of experience in the management of mechanical water or wastewater treatment plant construction projects; and shall have successfully managed the completion of a minimum of three (3) mechanical water or wastewater treatment plant construction projects as the project manager. Proposed project manager's experience including contracting company name, project name, location, initiation and completion dates of the contract, and project owner or engineer reference name and phone number shall be submitted for verification of this requirement and attached to the Qualifications Statement.
- G. Bidder shall have successfully executed Contracts with requirements similar to the Contract proposed for this Project. Bidders shall have an absence of failures to complete a contract awarded to it. Bidders that have previously failed to complete a contract awarded to it shall be determined to be unqualified. If any Bidder's Corporate Officer, Partner, Joint Venture participant or Proprietor has ever failed to complete a construction contract awarded to them in their name or when acting as a principal of another entity, they shall be determined to be unqualified.
- H. Bidder or any of its officers or any of its partners, if a partnership, or any of the individual entities, if a joint venture, shall have an absence of judgments involving the Bidder's failure to satisfy the requirements of Contracts.
- I. Bidder shall have a worker's compensation Experience Modification Rate (EMR) of less than 1.25 for the last five years from the date of bid opening.
- J. Bidder shall have demonstrated financial solvency for the last three (3) years of operation from the date of bid opening.
- 3.06 A potential bidder may request the Owner modify the bidder qualification requirements. Request shall be made no later than 15 days prior to bid for Owner to review. If the review results in a change to the qualification requirements, the Owner will issue an addendum to this specification identifying the revised requirements.
- 3.07 After Bids are received, if the Owner determines a bidder to be not responsible, the Owner will provide, in writing, the reasons for the determination. The bidder may appeal the determination within the time period specified in the bidding documents by presenting additional information to the Owner. The Owner will consider the additional information before issuing its final determination. If the final determination affirms that the bidder is not responsible, the Owner will not execute a contract with any other bidder until two business days after the bidder determined to be not responsible has received the final determination.

ARTICLE 4 EXAMINATION OF BIDDING DOCUMENTS, OTHER RELATED DATA, AND SITE

4.01 Subsurface and Physical Conditions

- A. The Bidder's attention is called to Section 01 01 00 and 01 10 00 of the Contract Documents in the regards to Bidder's obligation to verify for himself and to his complete satisfaction all information concerning site and subsurface conditions.
- B. The Supplementary Conditions identify:
 - 1. Those reports of explorations and tests of subsurface conditions at or contiguous to the Site that Engineer has used in preparing the Bidding Documents.
 - 2. Those drawings of physical conditions in or relating to existing surface and subsurface structures at or contiguous to the Site (except Underground Facilities) that Engineer has used in preparing the Bidding Documents.
- C. Copies of reports and drawings referenced in paragraph 4.01.B will be made available by Owner to any Bidder on request. Those reports and drawings are not part of the Contract Documents, but the "technical data" contained therein upon which Bidder is entitled to rely as provided in paragraph 4.02 of the General Conditions has been identified and established in paragraph 4.02 of the Supplementary Conditions. Bidder is responsible for any interpretation or conclusion Bidder draws from any "technical data" or any other data, interpretations, opinions, or information contained in such reports or shown or indicated in such drawings.

4.02 Underground Facilities

- A. Information and data shown or indicated in the Bidding Documents with respect to existing Underground Facilities at or contiguous to the Site is based upon information and data furnished to Owner and Engineer by owners of such Underground Facilities, including Owner, or others.

4.03 Hazardous Environmental Condition

- A. The Supplementary Conditions identify those reports and drawings relating to a Hazardous Environmental Condition identified at the Site, if any, that ENGINEER has used in preparing the Bidding Documents.
- B. Copies of reports and drawings referenced in paragraph 4.03.A will be made available by Owner to any Bidder on request. Those reports and drawings are not part of the Contract Documents, but the "technical data" contained therein upon which Bidder is entitled to rely as provided in paragraph 4.06 of the General Conditions has been identified and established in paragraph 4.06 of the Supplementary Conditions. Bidder is responsible for any interpretation or conclusion Bidder draws from any "technical

- data” or any other data, interpretations, opinions, or information contained in such reports or shown or indicated in such drawings.
- 4.04 Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders with respect to subsurface conditions, other physical conditions and Underground Facilities, and possible changes in the Bidding Documents due to differing or unanticipated conditions appear in paragraphs 4.02, 4.03, and 4.04 of the General Conditions. Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders with respect to a Hazardous Environmental Condition at the Site, if any, and possible changes in the Contract Documents due to any Hazardous Environmental Condition uncovered or revealed at the Site which was not shown or indicated in the Drawings or Specifications or identified in the Contract Documents to be within the scope of the Work appear in paragraph 4.06 of the General Conditions.
- 4.05 On request, Owner will provide Bidder access to the Site to conduct such examinations, investigations, explorations, tests, and studies as Bidder deems necessary for submission of a Bid. Bidder shall fill all holes and clean up and restore the Site to its former condition upon completion of such explorations, investigations, tests, and studies. Bidder shall comply with all applicable Laws and Regulations relative to locating of excavation and utility.
- 4.06 Additional Owner Provided Information:
- A. Reference is made to Article 7 of the Supplementary Conditions for the identification of the general nature of other work that is to be performed at the Site by Owner or others (such as utilities and other prime contractors) that relates to the Work contemplated by these Bidding Documents. On request, Owner will provide to each Bidder for examination access to or copies of Contract Documents (other than portions thereof related to price) for such other work.
- B. Paragraph 6.13.C of the General Conditions states that if an Owner safety program exists it will be noted in the Supplementary Conditions.
- 4.07 It is the responsibility of each Bidder before submitting a Bid to:
- A. Examine and carefully study the Bidding Documents, the other related data identified in the Bidding Documents, and any Addenda;
- B. Visit the Site and become familiar with and satisfy Bidder as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work;
- C. Become familiar with and satisfy Bidder as to all Federal, Tribal, State, and local Laws and Regulations that may affect cost, progress, or performance of the Work including but not limited to American Iron and Steel requirements as mandated by Section 746 of Title VII of the Consolidated Appropriations Act of 2017 (Division A - Agriculture, Rural Development, Food and Drug Administration, and Related Agencies

- Appropriations Act, 2017) and subsequent statutes mandating domestic preference which apply to the following products made primarily of iron or steel: lined or unlined pipes and fittings, manhole covers and other municipal castings, hydrants, tanks, flanges, pipe clamps and restraints, valves, structural steel, reinforced precast concrete, and construction materials.
- D. Carefully study all: (1) reports of explorations and tests of subsurface conditions at or contiguous to the Site and all drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site (except Underground Facilities) which have been identified in the Supplementary Conditions as provided in paragraph 4.02 of the General Conditions, and (2) reports and drawings of Hazardous Environmental Conditions at the Site which have been identified in the Supplementary Conditions as provided in paragraph 4.06 of the General Conditions;
 - E. Obtain and carefully study (or accept consequences for not doing so) all additional or supplementary examinations, investigations, explorations, tests, studies, and data concerning conditions (surface, subsurface, and Underground Facilities) at or contiguous to the Site which may affect cost, progress, or performance of the Work or which relate to any aspect of the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder, including applying any specific means, methods, techniques, sequences, and procedures of construction expressly required by the Bidding Documents, and safety precautions and programs incident thereto;
 - F. Agree at the time of submitting its Bid that no further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of its Bid for performance of the Work at the price(s) bid and within the times and in accordance with the other terms and conditions of the Bidding Documents;
 - G. Become aware of the general nature of the work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents;
 - H. Correlate the information known to Bidder, information and observations obtained from visits to the Site, reports and drawings identified in the Bidding Documents, and all additional examinations, investigations, explorations, tests, studies, and data with the Bidding Documents;
 - I. Promptly give Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder discovers in the Bidding Documents and confirm that the written resolution thereof by Engineer is acceptable to Bidder; and
 - J. Determine that the Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance of the Work.
- 4.08 The submission of a Bid will constitute an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article 4, that without exception the

Bid is premised upon performing and furnishing the Work required by the Bidding Documents and applying any specific means, methods, techniques, sequences, and procedures of construction that may be shown or indicated or expressly required by the Bidding Documents, that Bidder has given Engineer written notice of all conflicts, errors, ambiguities, and discrepancies that Bidder has discovered in Bidding Documents and the written resolutions thereof by Engineer are acceptable to Bidder, and that the Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performing and furnishing the Work.

ARTICLE 5 PRE-BID CONFERENCE

5.01 In some cases, Owner may choose to hold a pre-Bid conference. If Owner chooses to hold a pre-Bid conference the time, date, location, and attendance requirements of the pre-Bid conference will be defined in the bid advertisement and/or in Section 01 01 00. Engineer will transmit to all prospective Bidders of record such Addenda as Engineer considers necessary in response to questions arising at the conference. Oral statements may not be relied upon and will not be binding or legally effective.

ARTICLE 6 SITE AND OTHER AREAS

6.01 The Site is identified in the Bidding Documents. Easements for permanent structures or permanent changes in existing facilities are to be obtained and paid for by Owner unless otherwise provided in the Bidding Documents. All additional lands and access thereto required for temporary construction facilities, construction equipment, or storage of materials and equipment to be incorporated in the Work are to be obtained and paid for by Contractor.

ARTICLE 7 INTERPRETATIONS AND ADDENDA

7.01 All questions about the meaning or intent of the Bidding Documents are to be submitted to Engineer in writing. Interpretations or clarifications considered necessary by Engineer in response to such questions will be issued by Addenda mailed or delivered to all parties recorded by Engineer as having received the Bidding Documents. Questions received less than five days prior to the date for opening of Bids may not be answered. Only questions answered by Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect.

7.02 Addenda may be issued to clarify, correct, or change the Bidding Documents as deemed advisable by Owner or Engineer.

ARTICLE 8 BID SECURITY

8.01 A Bid must be accompanied by Bid security made payable to Owner in an amount of 5 % of Bidder's maximum Bid price and in the form of a certified check or a Bid bond (EJCDC No. C-430, 2007 Edition) issued by a surety meeting the requirements of paragraphs 5.01 and 5.02 of the General Conditions.

- 8.02 The Bid security of the Successful Bidder will be retained until such Bidder has executed the Contract Documents, furnished the required contract security and met the other conditions of the Notice of Award, whereupon the Bid security will be returned. If the Successful Bidder fails to execute and deliver the Contract Documents and furnish the required contract security within 15 days after the Notice of Award, Owner may annul the Notice of Award and the Bid security of that Bidder will be forfeited. The Bid security of other Bidders whom Owner believes to have a reasonable chance of receiving the award may be retained by Owner until the earlier of seven days after the Effective Date of the Agreement or 61 days after the Bid opening, whereupon Bid security furnished by such Bidders will be returned.
- 8.03 Bid security of other Bidders whom OWNER believes do not have a reasonable chance of receiving the award will be returned within seven days after the Bid opening.

ARTICLE 9 CONTRACT TIMES

- 9.01 Contract Time of completion of the work to be performed under this Contract is the essence of the Contract. Delays and extensions of time may be allowed in accordance with the provisions of the "General Conditions". The time allowed for intermediate milestones and completion of the work is set forth in Section 01 01 00 of these Contract Documents.

ARTICLE 10 LIQUIDATED DAMAGES

- 10.01 Contractor and Owner recognize that time is of the essence and that the Owner will suffer financial loss if the Work and/or defined Milestone(s) are not completed within the times specified in Specification Section 01 01 00 [Special Requirements/Bid Items], plus any extensions thereof allowed in accordance with Article 12 of the General Conditions. The parties also recognize the delays, expense, and difficulties involved in proving in a legal or arbitration proceeding the actual loss suffered by Owner if the Work and/or defined Milestone(s) are not Completed on time. Accordingly, instead of requiring any such proof, Owner and Contractor agree that as liquidated damages for delay (but not as a penalty), Contractor will pay for each day that expires after the time specified in Specification Section 01 01 00 for Substantial Completion until the Work and/or defined Milestone(s) are substantially complete. After Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Time or any proper extension thereof granted by Owner, Contractor shall pay the Owner for each day that expires after the time specified in Specification Section 01 01 00 for completion and readiness for final payment until the Work is completed and ready for final payment. The Contractor agrees that any such deduction shall not in any way release the Contractor from further obligations and liabilities with respect to fulfillment of the provisions of the Contract.
- 10.02 The amount of liquidated damages set forth above shall be assessed cumulatively. This provision for liquidated damages does not bar Owner's right to enforce other rights and

remedies against the Contractor including, but not limited to, specific performance or injunctive relief. Additional information concerning liquidated damages may be set forth in Specification Section 01 01 00.

- 10.03 The Contractor, by entering into an agreement with the Owner to construct the project, thereby authorizes the Owner to deduct such liquidated damages and engineering and inspection costs from the amounts due, or to become due the Contractor, and agrees that any such deduction shall not in any way release him from further obligations and liabilities with respect to fulfillment of the provisions of the Contract Documents.

ARTICLE 11 SUBSTITUTE AND “OR-EQUAL” ITEMS

- 11.01 The Contract for the Work, if awarded, will be on the basis of materials and equipment specified or described in the Bidding Documents, and those “or-equal” or substitute materials and equipment subsequently approved by Engineer prior to the submittal of Bids and identified by Addendum. No item of material or equipment will be considered by Engineer as an “or-equal” or substitute unless written request for approval has been submitted by Bidder and has been received by Engineer at least 15 days prior to the date for receipt of Bids in the case of a proposed substitute and 5 days prior in the case of a proposed “or-equal.” Each such request shall comply with the requirements of Paragraph 6.05 of the General Conditions and the specifications. Each such request shall include Manufacturer’s Certification letter for compliance with Section 746 of Title VII of the Consolidated Appropriations Act of 2017 (Division A - Agriculture, Rural Development, Food and Drug Administration, and Related Agencies Appropriations Act, 2017) and subsequent statutes mandating domestic preference, if applicable. Refer to Manufacturer’s Certification Letter provided in these Contract Documents. The burden of proof of the merit of the proposed item is upon Bidder. Engineer’s decision of approval or disapproval of a proposed item will be final. If Engineer approves any such proposed item, such approval will be set forth in an Addendum issued to all prospective Bidders. Bidders shall not rely upon approvals made in any other manner. Substitutes and “or-equal” materials and equipment may be proposed by Contractor in accordance with Paragraph 6.05 of the General Conditions after the Effective Date of the Contract.
- 11.02 All prices that Bidder sets forth in its Bid shall be based on the presumption that the Contractor will furnish the materials and equipment specified or described in the Bidding Documents, as supplemented by Addenda. Any assumptions regarding the possibility of post-Bid approvals of “or-equal” or substitution requests are made at Bidder’s sole risk.
- 11.03 If an award is made, Contractor shall be allowed to submit proposed substitutes and “or-equals” in accordance with the General Conditions.
- 11.04 Determination of whether an alternate material or product request is a substitute request or an “or-equal” request, regardless of how it is labeled upon receipt, will be based on the sole judgement of the Engineer.

- 11.05 In the event the Engineer's review of a requested substitute does not conclude during the Bid period, the Bid shall not be based on the requested substitute. Bid shall be based on approved manufacturers only, as indicated in the specifications and addendum(s) only.

ARTICLE 12 SUBCONTRACTORS, SUPPLIERS, AND OTHERS

- 12.01 If the Contract Documents require the identity of certain Subcontractors, Suppliers, individuals, or entities to be submitted to Owner in advance of a specified date prior to the Effective Date of the Agreement, the apparent Successful Bidder, and any other Bidder so requested, shall within five days after Bid opening, submit to Owner a list of all such Subcontractors, Suppliers, individuals, or entities proposed for those portions of the Work for which such identification is required. Such list shall be accompanied by an experience statement with pertinent information regarding similar projects and other evidence of qualification for each such Subcontractor, Supplier, individual, or entity if requested by Owner. If Owner or Engineer, after due investigation, has reasonable objection to any proposed Subcontractor, Supplier, individual, or entity, Owner may, before the Notice of Award is given, request apparent Successful Bidder to submit a substitute, without an increase in the Bid.
- 12.02 If apparent Successful Bidder declines to make any such substitution, Owner may award the Contract to the next lowest responsible Bidder that proposes to use acceptable Subcontractors, Suppliers, individuals, or entities. Declining to make requested substitutions will not constitute grounds for forfeiture of the Bid security of any Bidder. Any Subcontractor, Supplier, individual, or entity so listed and against which Owner and Engineer makes no written objection prior to the giving of the Notice of Award will be deemed acceptable to Owner and Engineer subject to revocation of such acceptance after the Effective Date of the Agreement as provided in paragraph 6.06 of the General Conditions.
- 12.03 Contractor shall not be required to employ any Subcontractor, Supplier, individual, or entity against whom Contractor has reasonable objection.
- 12.04 The Contractor shall not award work to Subcontractor(s) in excess of the limits stated in SC 6.06.

ARTICLE 13 PREPARATION OF BID

- 13.01 All Bids must be made on the Bid Forms provided in the Contractor Documents (pink perforated pages to be torn out).
- 13.02 All blanks on the Bid form shall be completed in ink and the Bid signed in ink. No changes shall be made in the forms, any erasures or alternations shall be initialed in ink by the person signing the Bid Form. Bid price shall be indicated for each Bid item listed herein. In case of discrepancy between unit prices and total, unit prices will prevail. See *Advertisement For Bids* for additional bidding requirements.

- 13.03 The Owner reserves the right to increase or diminish the amount of any class or item of work that may be deemed necessary. This applies to all unit price and lump sum bid items.
- 13.04 A Bid by a corporation shall be executed in the corporate name by the president or a vice-president or other corporate officer accompanied by evidence of authority to sign. The corporate seal shall be affixed and attested by the secretary or an assistant secretary. The corporate address and state of incorporation shall be provided on the Bid Form.
- 13.05 A Bid by a partnership shall be executed in the partnership name and signed by a partner (whose title must appear under the signature), accompanied by evidence of authority to sign. The official address of the partnership shall be provided on the Bid Form.
- 13.06 A Bid by a limited liability company shall be executed in the name of the firm by a member and accompanied by evidence of authority to sign. The state of formation of the firm and the official address of the firm shall be shown.
- 13.07 A Bid by an individual shall show the Bidder's name and business address.
- 13.08 A Bid by a joint venture shall be executed by each joint venturer in the manner indicated on the Bid form. The official address of the joint venture must be provided on the Bid Form.
- 13.09 All names shall be printed in ink below the signatures.
- 13.10 The Bid shall contain an acknowledgment of receipt of all Addenda, the numbers and dates of which shall be filled in on the Bid form.
- 13.11 The postal and email addresses and telephone number for communication regarding the Bid shall be shown.
- 13.12 The Bid shall contain evidence of Bidder's authority and qualification to do business in the state or locality where the Project is located or Bidder shall covenant in writing to obtain such qualification prior to award of the Contract and attach such covenant to the Bid. Bidder's state contractor license number, if any, shall also be shown on the Bid Form.
- 13.13 Retail sales tax, when payable by the Owner, will be paid as a separate item and shall be included in the proposal as indicated.

ARTICLE 14 BASIS OF BID, COMPARISON OF BIDS

14.01 Unit Price

- A. Bidders shall submit a Bid on a unit price basis for each item of Work listed in the Bid schedule.

- B. The total of all bid prices will be the sum of the products of the estimated quantity of each item and the corresponding unit price. The final quantities and Contract Price will be determined in accordance with paragraph 11.03 of the General Conditions.
- C. Discrepancies between the multiplication of units of Work and unit prices will be resolved in favor of the unit prices. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum. Discrepancies between words and figures will be resolved in favor of the words.

ARTICLE 15 SUBMITTAL OF BID

- 15.01 The bidder shall submit their bid on the forms furnish in the Bidding Documents (perforated pink pages). The Bid consists of all pages outlined in the index to Contract Documents and shall be submitted completed.
- 15.02 A Bid shall be submitted no later than the date and time prescribed and at the place indicated in the Advertisement for Bids and shall be enclosed in an opaque sealed envelope plainly marked with the Project title (and, if applicable, the designated portion of the Project for which the Bid is submitted), the name and address of Bidder, and shall be accompanied by the Bid security and other required documents. If a Bid is sent by mail or other delivery system, the sealed envelope containing the Bid shall be enclosed in a separate envelope plainly marked on the outside with the notation "BID ENCLOSED." When using the mail or other delivery system, the Bidder is totally responsible for the mail or other delivery system delivering the Bid at the place and prior to the time indicated in the Advertisement for Bid. A mailed Bid shall be addressed to Owner at address in Article 1.01 of Bid Form.

ARTICLE 16 MODIFICATION AND WITHDRAWAL OF BID

- 16.01 A Bid may be modified or withdrawn by an appropriate document duly executed in the manner that a Bid must be executed and delivered to the place where Bids are to be submitted prior to the date and time for the opening of Bids.
- 16.02 If within 24 hours after Bids are opened any Bidder files a duly signed written notice with Owner and promptly thereafter demonstrates to the reasonable satisfaction of Owner that there was a material and substantial mistake in the preparation of its Bid, that Bidder may withdraw its Bid, and the Bid security will be returned. Thereafter, if the Work is rebid or negotiated, that Bidder will be disqualified from further bidding on the Work. This provision to withdraw a Bid without forfeiting the Bid security does not apply to Bidder's errors in judgment in preparing the Bid.

ARTICLE 17 OPENING OF BIDS

- 17.01 Bids will be opened at the time and place indicated in the Advertisement for Bids and, unless obviously non-responsive, read aloud publicly. An abstract of the amounts of the

Bids and major alternates, if any, will be made available to Bidders after the opening of Bids.

ARTICLE 18 BIDS TO REMAIN SUBJECT TO ACCEPTANCE

18.01 All Bids will remain subject to acceptance for the period of time stated in the Bid Form, but Owner may, at its sole discretion, release any Bid and return the Bid security prior to the end of this period.

ARTICLE 19 EVALUATION OF BIDS AND AWARD OF CONTRACT

19.01 Owner reserves the right to reject any or all Bids, including without limitation, nonconforming, nonresponsive, unbalanced, or conditional Bids. Owner further reserves the right to reject the Bid of any Bidder whom it finds, after reasonable inquiry and evaluation, to be non-responsible. Owner also reserves the right to waive all informalities not involving price, time, or changes in the Work.

19.02 More than one Bid for the same Work from an individual or entity under the same or different names will not be considered. Reasonable grounds for believing that any Bidder has an interest in more than one Bid for the Work may be cause for disqualification of that Bidder and the rejection of all Bids in which that Bidder has an interest.

19.03 In evaluating Bids, Owner will consider whether or not the Bids comply with the prescribed requirements, and such alternates, unit prices and other data, as may be requested in the Bid Form or prior to the Notice of Award.

19.04 In evaluating Bidders, Owner will consider the qualifications of Bidders and may consider the qualifications and experience of Subcontractors, Suppliers, and other individuals or entities proposed for those portions of the Work for which the identity of Subcontractors, Suppliers, and other individuals or entities must be submitted as provided in the Contract Documents.

19.05 Owner may conduct such investigations as Owner deems necessary to establish the responsibility, qualifications, and financial ability of Bidders, proposed Subcontractors, Suppliers, individuals, or entities to perform the Work in accordance with the Contract Documents.

19.06 Within sixty (60) days after the opening of Bids, the Owner will either accept one Bid or reject any or all Bids. The award will be made by the Owner on the basis of that Bid from the lowest responsive, responsible, qualified Bidder, and which, in the Owner's sole and absolute judgment, will best serve the interest of the Owner. The acceptance of the Bid will be by written notice, mailed or delivered to the office designated in the Bid. In the event of failure of the lowest responsible bidder to sign and return the Agreement with acceptable "Performance Bond" and "Payment Bond" as prescribed herein, the Owner may award the Contract to the next lowest responsible Bidder. Such award, if made, will be within ninety (90) days after the opening Bids.

Further information concerning Contract award may be set forth in Section 01 01 00 of the Contract Documents.

ARTICLE 20 CONTRACT SECURITY AND INSURANCE

20.01 Article 5 of the General Conditions, as may be modified by the Supplementary Conditions, sets forth Owner's requirements as to performance and payment bonds and insurance. When the Successful Bidder delivers the executed Agreement to Owner, it shall be accompanied by such bonds.

20.02 The Bidder who has a Contract awarded to him and who fails to promptly and properly execute the Agreement and furnish the required "Performance Bond" and "Payment Bond", shall forfeit the bid security that accompanied his Bid, and the bid security shall be retained as liquidated damages by the Owner, and it is agreed that this said sum is a fair estimate of the amount of damages the Owner will sustain in the case the Bidder fails to enter into the Contract and furnish the bonds as herein before provided. Bid security deposited in the form of a certified check, or cashier's check shall be subject to the same requirements as a bid bond.

ARTICLE 21 SIGNING OF AGREEMENT

21.01 When Owner gives a Notice of Award to the Successful Bidder, it shall be accompanied by the required number of unsigned counterparts of the Agreement with the other Contract Documents which are identified in the Agreement as attached thereto. Within 15 days thereafter, Successful Bidder shall sign and deliver the required number of counterparts of the Agreement and attached documents to Owner. Within ten days thereafter, Owner shall deliver one fully signed counterpart to Successful Bidder with a complete set of the Drawings with appropriate identification.

21.02 This Contract may be funded in part with funds provided by the United States Department of Agriculture, Rural Utilities Service (RUS) and/or other Federal or State funding agencies. Refer elsewhere in these Contract Documents for Federal and/or State requirements.

21.03 If this Project is funded by RUS, concurrence by RUS in the award of the Contract is required before the Contract is effective. Other Federal or State funding agencies may also require concurrence in the award of the Contract before the Contract is effective.

ARTICLE 22 UNUSED

ARTICLE 23 UNUSED

ARTICLE 24 WAGE RATE REQUIREMENTS

- 24.01 In the State of Washington, the hourly minimum wage rate shall not be less than the prevailing wage rate paid to laborers, workmen or mechanics in each trade or occupation in the area.
- 24.02 Current Washington State laws and labor standard provisions shall apply to Project Work.
- 24.03 Section 746 of Title VII of the Consolidated Appropriations Act of 2017 (Division A - Agriculture, Rural Development, Food and Drug Administration, and Related Agencies Appropriations Act, 2017) and subsequent statutes mandating domestic preference applies an American Iron and Steel requirement to this project. All iron and steel products used in this project must be produced in the United States. The term "iron and steel products" means the following products made primarily of iron or steel: lined or unlined pipes and fittings, manhole covers and other municipal castings, hydrants, tanks, flanges, pipe clamps and restraints, valves, structural steel, reinforced precast concrete, and construction materials. The de minimis and minor components waiver apply to this contract."

Bid Form

Project Identification: **City of Leavenworth,
Wastewater Treatment Plant Improvement Project**

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ARTICLE 1 – BID RECIPIENT

- 1.01 This Bid Is Submitted To:
 - City of Leavenworth, 700 Highway 2 / PO Box 287, Leavenworth, WA 98826
 - ATTN: City Clerk

- 1.02 The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into an Agreement with Owner in the form included in the Bidding Documents to perform all Work as specified or indicated in the Bidding Documents for the prices and within the times indicated in the Bid and in accordance with the other terms and conditions of the Bidding Documents.

ARTICLE 2 – BIDDER’S ACKNOWLEDGMENTS

- 2.01 Bidder accepts all of the terms and conditions of the Advertisement and Instructions to Bidders, including without limitations those dealing with the dispositions of Bid security. The Bid will remain subject to acceptance for 60 days after the Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of Owner.

ARTICLE 3 – BIDDER’S REPRESENTATIONS

- 3.01 In submitting this Bid, Bidder represents that:
 - A. Bidder has examined and carefully studied the Bidding Documents, the other related data identified in the Bidding Documents, and the following Addenda, receipt of which is hereby acknowledged:

Addendum No.	Addendum Date
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

- B. Bidder has visited the Site and become familiar with and is satisfied as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
- C. Bidder is familiar with and is satisfied as to all Federal, State, and local Laws and Regulations that may affect cost, progress, and performance of the Work and including all American and Iron and Steel requirements.
- D. Bidder has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or contiguous to the Site and all drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site (except Underground Facilities) which have been identified in SC-4.02, and (2) reports and drawings of Hazardous Environmental Conditions, if any, at the Site that have been identified in SC-4.06 as containing reliable “technical data.”
- E. Bidder has considered the information known to Bidder; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and the Site-related reports and drawings identified in the Bidding Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder, including applying the specific means, methods, techniques, sequences, and procedures of construction expressly required by the Bidding Documents; and (3) Bidder’s safety precautions and programs.
- F. Based on the information and observations referred to in Paragraph 3.01.E above, Bidder does not consider that any further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of this Bid for performance of the Work at the price(s) bid and within the times and in accordance with the other terms and conditions of the Bidding Documents.
- G. Bidder is aware of the general nature of the Work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents.
- H. Bidder has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Bidding Documents, and the written resolution thereof by Engineer is acceptable to Bidder.

- I. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance of the Work for which this Bid is submitted.
- J. Bidder will submit written evidence of its authority to do business in the State or other jurisdiction where the Project is located not later than the date of its execution of the Agreement.

ARTICLE 4 – BIDDER’S CERTIFICATION

4.01 Bidder further represents that:

- A. This Bid is genuine and not made in the interest of or on the behalf of any undisclosed individual or entity and is not submitted in conformity with any agreement or rules of any group, association, organization, or corporation;
- B. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid;
- C. Bidder has not solicited or induced any individual or entity to refrain from bidding; and
- D. Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract. For the purposes of this Paragraph 4.01.D:
 - 1. “corrupt practice” means the offering, giving, receiving, or soliciting of any thing of value likely to influence the action of a public official in the bidding process;
 - 2. “fraudulent practice” means an intentional misrepresentation of facts made (a) to influence the bidding process to the detriment of Owner, (b) to establish bid prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;
 - 3. “collusive practice” means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish bid prices at artificial, non-competitive levels; and
 - 4. “coercive practice” means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

ARTICLE 5 – BASIS OF BID

5.01 Bidder will complete the Work in accordance with the Contract Documents for the price(s) indicated on the Unit Price Sheet(s).

Unit Prices have been computed in accordance with paragraph 11.03.B of the General Conditions.

Bidder acknowledges that estimated quantities are not guaranteed, and are solely for the purpose of comparison of Bids, and final payment for all Unit Price Bid items will be based on actual quantities, determined as provided in the Contract Documents.

ARTICLE 6 – TIME OF COMPLETION

- 6.01 Bidder agrees that the Work will be substantially complete and will be completed and ready for final payment in accordance with paragraph 14.07 of the General Conditions on or before the dates or within the number of calendar days indicated in the Agreement.
- 6.02 Bidder accepts the provisions of the Agreement as to liquidated damage.

ARTICLE 7 – ATTACHMENTS TO THIS BID

- 7.01 The Index lists all required attachments to the Bid. All items listed under Bid in the Index are made a condition of the Bid:

ARTICLE 8 – DEFINED TERMS

- 8.01 The terms used in this Bid with the initial capital letters have the meanings indicated in the Instructions to Bidders, the General Conditions, and the Supplementary Conditions.

ARTICLE 9 – BID SUBMITTAL

9.01 This Bid is submitted by:

If Bidder is:

An Individual

Name (typed or printed): _____

By: _____
(*Individual's signature*)

Doing business as: _____

A Partnership

Partnership Name: _____

By: _____
(*Signature of general partner -- attach evidence of authority to sign, or provide prior to award*)

Name (typed or printed): _____

A Corporation

Corporation Name: _____

State or Jurisdiction of Incorporation: _____

Type (General Business, Profession, Service, Limited Liability): _____

By: _____
(*Signature -- attach evidence of authority to sign, or provide prior to award*)

Name (typed or printed): _____

Title: _____

Attest _____
(*Signature of Corporate Secretary*)

Date of Qualification to do business in _____ [State or other jurisdiction where Project is located] is ___/___/_____

Bidder's Business address: _____

Business Phone No. (____) _____

Business FAX No. (____) _____

Business E-Mail Address _____

State Contractor License No. _____ (If applicable)

Employer Identification No. (EIN) *aka* Federal Tax ID No. (TIN) _____

WA State Unified Business Identifier (UBI) No. _____

Phone and FAX Numbers, and Address for receipt of official communications, if different from
Business contact information:

9.02 Bid submitted on _____, 20__.

UNIT PRICE SHEETS
 CITY OF LEAVENWORTH, WA
 Wastewater Treatment Plant Improvements

BASE BID

BIDDER: _____

The BIDDER agrees to perform the work described in the CONTRACT DOCUMENTS for the following unit or lump sum prices:

SECTION	(Bid Item No.) DESCRIPTION	ESTIMATED QUANTITY	UNIT PRICE	AMOUNT
01 01 00	Special Requirements / Bid Items			
	(1) All Work Not Included In Bid Items 2 - 5	Lump Sum	\$ Lump Sum	\$ _____
	(2) SWPP/SPP Plan	Lump Sum	\$ Lump Sum	\$ _____
	(3) Minor Changes	50,000 EA	\$ 1.00	\$ 50,000
Div 26	Electrical			
	WWTP Electrical			
	(4) (not including Schedules A, B and C)	Lump Sum	\$ Lump Sum	\$ _____
31 23 00	Trench Excavation, Backfill and Compaction			
	(5) Trench Excavation Safety System	Lump Sum	\$ Lump Sum	\$ _____
			BASE BID SUBTOTAL	\$ _____
			SALES TAX (8.4%)	\$ _____
			TOTAL BASE BID AMOUNT	\$ _____

UNIT PRICE SHEETS
 CITY OF LEAVENWORTH, WA
 Wastewater Treatment Plant Improvements

SCHEDULE A: UV SYSTEM UPGRADE

BIDDER: _____

The BIDDER agrees to perform the work described in the CONTRACT DOCUMENTS for the following unit or lump sum prices:

SECTION	(Bid Item No.) DESCRIPTION	ESTIMATED QUANTITY	UNIT PRICE	AMOUNT
01 01 00	Special Requirements / Bid Items			
	UV Building Demolition and			
	(A1) Improvements	<u>Lump Sum</u>	\$ <u>Lump Sum</u>	\$ _____
	(A2) Schedule A Electrical	<u>Lump Sum</u>	\$ <u>Lump Sum</u>	\$ _____
46 66 23	Ultraviolet Disinfection System			
	(A3) Ultraviolet Disinfection System	<u>Lump Sum</u>	\$ <u>Lump Sum</u>	\$ _____
		SCHEDULE A SUBTOTAL		\$ _____
		SALES TAX (8.4%)		\$ _____
		SCHEDULE A TOTAL AMOUNT		\$ _____

UNIT PRICE SHEETS
CITY OF LEAVENWORTH, WA
Wastewater Treatment Plant Improvements

SCHEDULE B: MECHANICAL DEWATERING IMPROVEMENTS

BIDDER: _____

The BIDDER agrees to perform the work described in the CONTRACT DOCUMENTS for the following unit or lump sum prices:

SECTION	(Bid Item No.) DESCRIPTION	ESTIMATED QUANTITY	UNIT PRICE	AMOUNT
01 01 00	Special Requirements / Bid Items			
	Dewatering Building Demolition and			
	(B1) Improvements	<u>Lump Sum</u>	\$ <u>Lump Sum</u>	\$ _____
	(B2) Schedule B Electrical	<u>Lump Sum</u>	\$ <u>Lump Sum</u>	\$ _____
46 76 33	Decanter Centrifuge System			
	(B3) Decanter Centrifuge Dewatering System	<u>Lump Sum</u>	\$ <u>Lump Sum</u>	\$ _____
SCHEDULE B SUBTOTAL				\$ _____
SALES TAX (8.4%)				\$ _____
SCHEDULE B TOTAL AMOUNT				\$ _____

Centrifuge Alternate Model:

If Bid Item B4 is selected by the Owner it will replace Bid Item B3.

46 76 33	Decanter Centrifuge System			
	Decanter Centrifuge Dewatering System			
	(B4) (Reduced Capacity)	<u>Lump Sum</u>	\$ <u>Lump Sum</u>	\$ _____

UNIT PRICE SHEETS
 CITY OF LEAVENWORTH, WA
 Wastewater Treatment Plant Improvements

SCHEDULE C: CLARIFIER IMPROVEMENTS

BIDDER: _____

The BIDDER agrees to perform the work described in the CONTRACT DOCUMENTS for the following unit or lump sum prices:

SECTION	(Bid Item No.) DESCRIPTION	ESTIMATED QUANTITY	UNIT PRICE	AMOUNT
01 01 00 Special Requirements / Bid Items				
	(C1) Clarifier Improvements	<u>Lump Sum</u>	\$ <u>Lump Sum</u>	\$ _____
	(C2) Schedule C Electrical	<u>Lump Sum</u>	\$ <u>Lump Sum</u>	\$ _____
		SCHEDULE C SUBTOTAL		\$ _____
		SALES TAX (8.4%)		\$ _____
		SCHEDULE C TOTAL AMOUNT		\$ _____

BIDDER'S QUALIFICATIONS STATEMENT

The BIDDER hereby furnishes the following information to the OWNER as a requirement of the BID. The BIDDER understands that failure to submit this information may be reason for the OWNER to reject his bid as a being non-responsive. The information supplied in this document is confidential to the extent permitted by laws and regulations.

1. SUBMITTED BY:

Official Name of Firm:

Address:

2. SUBMITTED TO:

3. SUBMITTED FOR:

Owner:

Project Name:

TYPE OF WORK:

4. CONTRACTOR'S CONTACT INFORMATION

Contact Person:

Title:

Phone:

Email:

5. AFFILIATED COMPANIES:

Name: _____

Address: _____

6. TYPE OF ORGANIZATION:

SOLE PROPRIETORSHIP

Name of Owner: _____

Doing Business As: _____

Date of Organization: _____

PARTNERSHIP

Date of Organization: _____

Type of Partnership: _____

Name of General Partner(s): _____

CORPORATION

State of Organization: _____

Date of Organization: _____

Executive Officers:

- President: _____

- Vice President(s): _____

- Treasurer: _____

- Secretary: _____

LIMITED LIABILITY COMPANY

State of Organization:

Date of Organization:

Members:

JOINT VENTURE

Sate of Organization:

Date of Organization:

Form of Organization:

Joint Venture Managing Partner

- Name:

- Address:

Joint Venture Managing Partner

- Name:

- Address:

Joint Venture Managing Partner

- Name:

- Address:

7. LICENSING

Jurisdiction: _____

Type of License: _____

License Number: _____

Jurisdiction: _____

Type of License: _____

License Number: _____

8. CERTIFICATIONS

CERTIFIED BY:

Disadvantage Business Enterprise: _____

Minority Business Enterprise: _____

Woman Owned Enterprise: _____

Small Business Enterprise: _____

Other (_____): _____

9. BONDING INFORMATION

Bonding Company: _____

Address: _____

Bonding Agent: _____

Address: _____

Contact Name: _____

Phone: _____

Aggregate Bonding Capacity: _____

Available Bonding Capacity as of date of this submittal: _____

10. FINANCIAL INFORMATION

Financial Institution: _____

Address: _____

Account Manager: _____

Phone: _____

INCLUDE AS AN ATTACHMENT AN AUDITED BALANCE SHEET FOR EACH OF THE
LAST 3 YEARS

11. CONSTRUCTION EXPERIENCE:

Current Experience:

List on **Schedule A** all uncompleted projects currently under contract (If Joint Venture list each participant's projects separately).

Previous Experience:

List on **Schedule B** all projects completed within the last 5 Years (If Joint Venture list each participant's projects separately).

Has firm listed in Section 1 ever failed to complete a construction contract awarded to it?

YES NO

If YES, attach as an Attachment details including Project Owner's contact information.

Has any Corporate Officer, Partner, Joint Venture participant or Proprietor ever failed to complete a construction contract awarded to them in their name or when acting as a principal of another entity?

YES NO

If YES, attach as an Attachment details including Project Owner's contact information.

Are there any judgments, claims, disputes or litigation pending or outstanding involving the firm listed in Section 1 or any of its officers (or any of its partners if a partnership or any of the individual entities if a joint venture)?

YES NO

If YES, attach as an Attachment details including Project Owner's contact information.

I HEREBY CERTIFY THAT THE INFORMATION SUBMITTED HEREWITH, INCLUDING ANY ATTACHMENTS, IS TRUE TO THE BEST OF MY KNOWLEDGE AND BELIEF.

NAME OF ORGANIZATION: _____

BY: _____

TITLE: _____

DATED: _____

NOTARY ATTEST:

SUBSCRIBED AND SWORN TO BEFORE ME

THIS _____ DAY OF _____, 20__

NOTARY PUBLIC - STATE OF _____

MY COMMISSION EXPIRES: _____

REQUIRED ATTACHMENTS

1. Schedule A (Current Experience).
2. Schedule B (Previous Experience).
3. Audited balance sheet for each of the last 3 years for firm named in Section 1. Audited balance sheet may be submitted or disclosed up to 48 hours after Bid Opening. In lieu of submission to the public record, audited balance sheet may be discussed by the Bidder in person directly to the Engineer for the purposes of verifying financial solvency.
4. Evidence of authority for individuals listed in Section 6 to bind organization to an agreement.
5. Resumes of officers and key individuals (including Project Superintendent, and Project Manager) of firm named in Section 1.
6. Additional items as pertinent.

SCHEDULE A

CURRENT EXPERIENCE

Project Name	Owner's Contact Person	Design Engineer	Contract Date	Type of Work	Status	Cost of Work
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				

SCHEDULE B

PREVIOUS EXPERIENCE (Include ALL Projects Completed within last 5 years)

Project Name	Owner's Contact Person	Design Engineer	Contract Date	Type of Work	Status	Cost of Work
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				

SCHEDULE B

PREVIOUS EXPERIENCE (Include ALL Projects Completed within last 5 years)

Project Name	Owner's Contact Person	Design Engineer	Contract Date	Type of Work	Status	Cost of Work
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				

BIDDER'S ELECTRICAL SUBCONTRACTOR QUALIFICATION STATEMENT

The Electrical Contractor and subcontractors shall provide a list of at least three (3) successful projects in the last seven (7) years for treatment systems or other facilities of similar scope and complexity. The proposing Electrical Contractor must have performed the installation, documentation, field-testing, and start-up for each listed project.

Statement of Electrical Subcontractor Qualifications:

1. Name of Electrical Subcontractor: _____
2. State UBI number: _____
3. Federal Tax Id / EIN: _____
4. Years in business: _____
5. List all projects in past 7 years similar to this project*

DATE	PROJECT	ELECTRICAL COST	OWNER/PHONE	ENGINEER/PHONE

ELECTRICAL SUBCONTRACTOR QUALIFICATION STATEMENT

Submitted by (bidder):

Company

Mailing Address

Signature

City, State Zip

Name and Title

**Attach additional pages if needed.*

BID BOND

Any singular reference to Bidder, Surety, Owner or other party shall be considered plural where applicable.

BIDDER *(Name and Address)*:

SURETY *(Name and Address of Principal Place of Business)*:

OWNER *(Name and Address)*:

BID

Bid Due Date:
Description *(Project Name and Include Location)*:

BOND

Bond Number:
Date *(Not earlier than Bid due date)*:
Penal sum _____

(Words)

\$

_____ (Figures)

Surety and Bidder, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Bid Bond to be duly executed by an authorized officer, agent, or representative.

BIDDER

SURETY

Bidder's Name and Corporate Seal

(Seal)

Surety's Name and Corporate Seal

(Seal)

By: _____
Signature

By: _____
Signature (Attach Power of Attorney)

Print Name

Print Name

Title

Title

Attest: _____
Signature

Attest: _____
Signature

Title

Title

Note: Above addresses are to be used for giving any required notice. Provide execution by any additional parties, such as joint venturers, if necessary.

1. Bidder and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to pay to Owner upon default of Bidder the penal sum set forth on the face of this Bond. Payment of the penal sum is the extent of Bidder's and Surety's liability. Recovery of such penal sum under the terms of this Bond shall be Owner's sole and exclusive remedy upon default of Bidder.
2. Default of Bidder shall occur upon the failure of Bidder to deliver within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents.
3. This obligation shall be null and void if:
 - 3.1 Owner accepts Bidder's Bid and Bidder delivers within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents, or
 - 3.2 All Bids are rejected by Owner, or
 - 3.3 Owner fails to issue a Notice of Award to Bidder within the time specified in the Bidding Documents (or any extension thereof agreed to in writing by Bidder and, if applicable, consented to by Surety when required by Paragraph 5 hereof).
4. Payment under this Bond will be due and payable upon default of Bidder and within 30 calendar days after receipt by Bidder and Surety of written notice of default from Owner, which notice will be given with reasonable promptness, identifying this Bond and the Project and including a statement of the amount due.
5. Surety waives notice of any and all defenses based on or arising out of any time extension to issue Notice of Award agreed to in writing by Owner and Bidder, provided that the total time for issuing Notice of Award including extensions shall not in the aggregate exceed 120 days from Bid due date without Surety's written consent.
6. No suit or action shall be commenced under this Bond prior to 30 calendar days after the notice of default required in Paragraph 4 above is received by Bidder and Surety and in no case later than one year after Bid due date.
7. Any suit or action under this Bond shall be commenced only in a court of competent jurisdiction located in the state in which the Project is located.
8. Notices required hereunder shall be in writing and sent to Bidder and Surety at their respective addresses shown on the face of this Bond. Such notices may be sent by personal delivery, commercial courier, or by United States Registered or Certified Mail, return receipt requested, postage pre-paid, and shall be deemed to be effective upon receipt by the party concerned.
9. Surety shall cause to be attached to this Bond a current and effective Power of Attorney evidencing the authority of the officer, agent, or representative who executed this Bond on behalf of Surety to execute, seal, and deliver such Bond and bind the Surety thereby.
10. This Bond is intended to conform to all applicable statutory requirements. Any applicable requirement of any applicable statute that has been omitted from this Bond shall be deemed to be included herein as if set forth at length. If any provision of this Bond conflicts with any applicable statute, then the provision of said statute shall govern and the remainder of this Bond that is not in conflict therewith shall continue in full force and effect.
11. The term "Bid" as used herein includes a Bid, offer, or proposal as applicable.

CERTIFICATION FOR CONTRACTS, GRANTS AND LOANS

The undersigned certifies, to the best of his or her knowledge and belief, that:

1. No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant or Federal loan, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant or loan.

2. If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant or loan, the undersigned shall complete and submit Standard Form - LLL, "Disclosure of Lobbying Activities," in accordance with its instructions.

3. The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including contracts, subcontracts, and subgrants under grants and loans) and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.

(name)

(date)

(title)

oOo

U.S. DEPARTMENT OF AGRICULTURE

CERTIFICATION REGARDING DEBARMENT, SUSPENSION, INELIGIBILITY AND VOLUNTARY EXCLUSION - LOWER TIER COVERED TRANSACTIONS

This certification is required by the regulations implementing Executive Order 12549, Debarment and Suspension, 7 CFR Part 3017, Section 3017.510, Participants' responsibilities. The regulations were published as Part IV of the January 30, 1989, Federal Register (pages 4722-4733). Copies of the regulations may be obtained by contacting the Department of Agriculture agency with which this transaction originated.

(BEFORE COMPLETING CERTIFICATION, READ INSTRUCTIONS ON REVERSE)

- (1) The prospective lower tier participant certifies, by submission of this proposal, that neither it nor its principals is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in this transaction by any Federal department or agency.
- (2) Where the prospective lower tier participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

Organization Name

PR/Award Number or Project Name

Name(s) and Title(s) of Authorized Representative(s)

Signature(s)

Date

Instructions for Certification

1. By signing and submitting this form, the prospective lower tier participant is providing the certification set out on the reverse side in accordance with these instructions.
2. The certification in this clause is a material representation of fact upon which reliance was placed when this transaction was entered into. If it is later determined that the prospective lower tier participant knowingly rendered an erroneous certification, in addition to other remedies available to the Federal Government, the department or agency with which this transaction originated may pursue available remedies, including suspension and/or debarment.
3. The prospective lower tier participant shall provide immediate written notice to the person to which this proposal is submitted if at any time the prospective lower tier participant learns that its certification was erroneous when submitted or has become erroneous by reason of changed circumstances.
4. The terms “covered transactions,” “debarred,” “suspended,” “ineligible,” “lower tier covered transactions,” “participant,” “person,” “primary covered transaction,” “principal,” “proposal,” and “voluntarily excluded,” as used in this clause, have the meanings set out in the Definitions and Coverage sections of rules implementing Executive Order 12549. You may contact the person to which this proposal is submitted for assistance in obtaining a copy of those regulations.
5. The prospective lower tier participant agrees by submitting this form that, should the proposed covered transaction be entered into, it shall not knowingly enter into any lower tier covered transaction with a person who is debarred, suspended, declared ineligible, or voluntarily excluded from participation in this covered transaction, unless authorized by the department or agency with which this transaction originated.
6. The prospective lower tier participant further agrees by submitting this form that it will include this clause titled “Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion - Lower Tier Covered Transactions,” without modification, in all lower tier covered transactions and in all solicitations for lower tier covered transactions.
7. A participant in a covered transaction may rely upon a certification of a prospective participant in a lower tier covered transaction that it is not debarred, suspended, ineligible, or voluntarily excluded from the covered transaction, unless it knows that the certification is erroneous. A participant may decide the method and frequency by which it determines the eligibility of its principals. Each participant may, but is not required to, check the Nonprocurement List.
8. Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render in good faith the certification required by this clause. The knowledge and information of a participant is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.
9. Except for transactions authorized under paragraph 5 of these instructions, if a participant in a covered transaction knowingly enters into a lower tier covered transaction with a person who is suspended, debarred, ineligible, or voluntarily excluded from participation in this transaction, in addition to other remedies available to the Federal Government, the department or agency with which this transaction originated may pursue available remedies, including suspension and/or debarment.

COMPLIANCE STATEMENT

This statement relates to a proposed contract with _____

(Name of borrower or grantee)

who expects to finance the contract with assistance from either the Rural Housing Service (RHS), Rural Business-Cooperative Service (RBS), or the Rural Utilities Service (RUS) or their successor agencies, United States Department of Agriculture (whether by a loan, grant, loan insurance, guarantee, or other form of financial assistance). I am the undersigned bidder or prospective contractor, I represent that:

1. I have, have not, participated in a previous contract or subcontract subject to Executive Order 11246 (regarding equal employment opportunity) or a preceding similar Executive Order.
2. If I have participated in such a contract or subcontract, I have, have not, filed all compliance reports that have been required to file in connection with the contract or subcontract.
 If the proposed contract is for \$50,000 or more: or If the proposed nonconstruction contract is for \$50,000 or more and I have 50 or more employees, I also represent that:
3. I have, have not previously had contracts subject to the written affirmative action programs requirements of the Secretary of Labor.
4. If I have participated in such a contract or subcontract, I have, have not developed and placed on file at each establishment affirmative action programs as required by the rules and regulations of the Secretary of Labor.

I understand that if I have failed to file any compliance reports that have been required of me, I am not eligible and will not be eligible to have my bid considered or to enter into the proposed contract unless and until I make an arrangement regarding such reports that is satisfactory to either the RHS, RBS or RUS, or to the office where the reports are required to be filed.

I also certify that I do not maintain or provide for my employees any segregated facilities at any of my establishments, and that I do not permit my employees to perform their services at any location, under my control, where segregated facilities are maintained. I certify further that I will not maintain or provide for my employees any segregated facilities at any of my establishments, and that I will not permit my employees to perform their services at any location, under my control, where segregated facilities are maintained. I agree that a breach of this certification is a violation of the Equal Opportunity clause in my contract. As used in this certification, the term "segregated facilities" means any waiting rooms, work areas, restrooms and wash rooms, restaurants and other eating areas time clocks, locker rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees which are segregated by explicit directive or are in fact segregated on the basis of race, creed, color, or national origin, because of habit, local custom, or otherwise. I further agree that (except where I have obtained identical certifications for proposed subcontractors for specific time periods) I will obtain identical certifications from proposed subcontractors prior to the award of subcontracts exceeding \$10,000 which are not exempt from the provisions of the Equal Opportunity clause; that I will retain such certifications in my files; and that I will forward the following notice to such proposed subcontractors (except where the proposed subcontractors have submitted identical certifications for specific time periods):

According to the Paperwork Reduction Act of 1995, an agency may not conduct or sponsor, and a person is not required to respond to a collection of information unless it displays the valid OMB control number. The valid OMB control number for this information collection is 0575-0018. The time required to complete this information collection is estimated to average 10 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

**NOTICE TO PROSPECTIVE SUBCONTRACTORS OF REQUIREMENTS FOR
CERTIFICATIONS OF NON-SEGREGATED FACILITIES**

A certification of Nonsegregated Facilities, as required by the May 9, 1967, order (32F.R. 7439, may 19, 1967) on Elimination of Segregated Facilities, by the Secretary of Labor, must be submitted prior to the award of a subcontract exceeding \$ 10,000 which is not exempt from the provisions of the Equal Opportunity clause. The certification may be submitted either for each subcontract or for all subcontracts during a period (i.e., quarterly, semiannually, or annually).

NOTE: The penalty for making false statements in offers is prescribed in 18 U.S.C. 1001.

DATE _____

(Signature of Bidder or Prospective Contractor)

Address (including Zip Code)

RCW 39.30.060.

Every invitation to bid on a contract that is expected to cost one million dollars or more for the construction, alteration, or repair of any public building or public work of the state or a state agency or municipality as defined under RCW 39.04.010, or an institution of higher education as defined under RCW 28B.10.016, shall require each prime contract bidder to submit as part of the bid, or within one hour after the published bid submittal time, the names of the subcontractors with whom the bidder, if awarded the contract, will subcontract for performance of the work of heating, ventilation, air conditioning, and plumbing as described in chapter 18.106 RCW, and electrical as described in chapter 19.28 RCW, **or to name itself for the work**. The prime contract bidder shall not list more than one subcontractor for each category of the work identified, unless subcontractors vary with bid alternates, in which case the bidder must indicate which subcontractor will be used for which alternate. Failure of the prime contract bidder to submit as part of the bid the names of such subcontractors **or to name itself** to perform such work or the naming of two or more subcontractors to perform the same work shall render the prime contractor bidder's bid nonresponsive and, therefore, void. The requirement of this section to name the prime contract bidder's proposed heating, ventilation and air conditioning, plumbing, and electrical subcontractors applies only to proposed heating, ventilation and air conditioning, plumbing, and electrical subcontractors who will contract directly with the prime contract bidder submitting the bid to the public entity.

It is the BIDDER'S sole responsibility to comply with these requirements.

BIDDER'S SUBCONTRACTOR LIST	
Categories of Work	Subcontractor Name/Address or Bidder's name if will self-perform heating, ventilation, air conditioning, plumbing or electric.

Notice of Award

Date: _____

Project:	
Owner:	Owner's Contract No.:
	Engineer's Project No.:
Bidder:	
Bidder's Address:	
Street	
City, State Zipcode	

You are notified that your Bid dated _____ for the above Contract has been considered. You are the Successful Bidder and are awarded a Contract for \$_____.

You must comply with the following conditions precedent within [15] days of the date you receive this Notice of Award.

1. Deliver to the Owner [3] fully executed counterparts of the Agreement (form attached hereto).
2. Deliver with the executed Agreement [3] executed counterparts of the Contract Bonds as specified in the Instructions to Bidders (Article 20) and General Conditions (Paragraph 5.01) (forms attached hereto).
3. Deliver with the executed Agreement and Bonds a Certificate of Insurance documenting the required coverage.

Failure to comply with these conditions within the time specified will entitle Owner to consider you in default, annul this Notice of Award, and declare your Bid security forfeited.

Within [10] days after you comply with the above conditions, Owner will return to you one fully executed counterpart of the Agreement.

Owner

By: _____
Authorized Signature

Title

Copy to Engineer

**AGREEMENT
BETWEEN OWNER AND CONTRACTOR
FOR CONSTRUCTION CONTRACT**

THIS AGREEMENT is by and between _____ (“Owner”) and

_____ (“Contractor”).

Owner and Contractor hereby agree as follows:

ARTICLE 1 – WORK

1.01 Contractor shall complete all Work as specified or indicated in the Contract Documents for [Project Name, Volumes (if applicable), date]. The Work is generally described in the Advertisement for Bids.

ARTICLE 2 – THE PROJECT

2.01 The Work under the Contract Documents may be the whole or only a part of a Project being undertaken by Owner.

ARTICLE 3 – ENGINEER

3.01 The Project has been designed by Varela & Associates, Inc. (Engineer), which is to act as Owner’s representative, assume all duties and responsibilities, and have the rights and authority assigned to Engineer in the Contract Documents in connection with the completion of the Work in accordance with the Contract Documents.

ARTICLE 4 – CONTRACT TIMES

4.01 *Time of the Essence*

A. All time limits for Milestones, if any, Substantial Completion, if any, completion and readiness for final payment, and any other time limits stated in the Contract Documents are of the essence of the Contract.

4.02 *Contract Time(s)*

A. Contract Time(s) to (1) achieve Milestones, if specified; (2) achieve Substantial Completion, if specified; (3) complete the Work so that it is ready for final payment; and (4) meet any other time limits stated in the Contract documents shall be as defined in Specification Section 01 01 00.

4.03 *Liquidated Damages*

- A. Contractor and Owner recognize that time is of the essence as stated in Paragraph 4.01 above and that Owner will suffer financial loss if the Work is not completed within the time(s) specified in Paragraph 4.02 above, plus any extensions thereof allowed in accordance with Article 12 of the General Conditions. The parties also recognize the delays, expense, and difficulties involved in proving in a legal or arbitration proceeding the actual loss suffered by Owner if the Work is not completed on time. Accordingly, instead of requiring any such proof, Owner and Contractor agree that as liquidated damages for failure to meet the Contract Times(s) (but not as a penalty), Contractor shall pay Owner Liquidated Damages as defined in Specification Section 01 01 00.

ARTICLE 5 – CONTRACT PRICE

- 5.01 Owner shall pay Contractor for completion of the Work in accordance with the Contract Documents an amount equal to the sum of the bid items shown on the Contractor's Bid. As provided in Paragraph 11.03 of the General Conditions, estimated quantities shown on the Bid form for Unit Price Work are not guaranteed. Payment amounts for Unit Price Work shall be based on the actual quantities of such items as provided in Paragraph 9.07 of the General Conditions.

- 5.02 Total Contract Price based on Contractor's Bid is \$ _____

ARTICLE 6 – PAYMENT PROCEDURES

6.01 *Submittal and Processing of Payments*

- A. Contractor shall submit Applications for Payment in accordance with Article 14 of the General Conditions. Applications for Payment will be processed by Engineer as provided in the General Conditions.

6.02 *Progress Payments; Retainage*

- A. Owner shall make progress payments on account of the Contract Price on the basis of Contractor's Applications for Payment and in accordance with Article 14 of the General Conditions. All such payments will be measured by the schedule of values established as provided in Paragraph 2.07.A of the General Conditions (and in the case of Unit Price Work based on the number of units satisfactorily completed) or, in the event there is no schedule of values, as provided in the General Requirements.
- B. Payments will be made in amounts determined in accordance with the Contract Documents but, in each case, less 5% retainage and less such amounts as Engineer may determine or Owner may withhold, including but not limited to liquidated damages, in accordance with Paragraph 14.02 of the General Conditions.
- C. Upon Substantial Completion, Owner shall pay an amount sufficient to increase total payments to Contractor to 100 percent of the Work completed, less 5% retainage, less such amounts as Engineer shall determine in accordance with Paragraph 14.02.B.5 of the General Conditions

and less 200 percent of Engineer's estimate of the value of Work to be completed or corrected as shown on the tentative list of items to be completed or corrected attached to the certificate of Substantial Completion.

6.03 *Final Payment*

- A. Upon final completion and acceptance of the Work in accordance with Paragraph 14.07 of the General Conditions, Owner shall pay the remainder of the Contract Price as recommended by Engineer as provided in said Paragraph 14.07. Retainage will not be released prior to Contractor completion of closeout requirements, including such state and/or federal documentation as applicable to the Work.

ARTICLE 7 – INTEREST

- 7.01 All moneys not paid when due as provided in Article 14 of the General Conditions shall bear interest at a rate of 5 percent annum.

ARTICLE 8 – CONTRACTOR'S REPRESENTATIONS

- 8.01 In order to induce Owner to enter into this Agreement, Contractor makes the following representations:
 - A. Contractor has examined and carefully studied the Contract Documents and the other related data identified in the Bidding Documents.
 - B. Contractor has visited the Site and become familiar with and is satisfied as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
 - C. Contractor is familiar with and is satisfied as to all federal, state, and local Laws and Regulations that may affect cost, progress, and performance of the Work.
 - D. Contractor has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or contiguous to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities), if any, that have been identified in Paragraph SC-4.02 of the Supplementary Conditions or Specification Section 01 01 00 as containing reliable "technical data," and (2) reports and drawings of Hazardous Environmental Conditions, if any, at the Site that have been identified in Paragraph SC-4.06 of the Supplementary Conditions as containing reliable "technical data."
 - E. Contractor has considered the information known to Contractor; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Contract Documents; and the Site-related reports and drawings identified in the Contract Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, including any specific means, methods, techniques, sequences, and procedures of construction expressly required by the Contract Documents; and (3) Contractor's safety precautions and programs.

- F. Based on the information and observations referred to in Paragraph 8.01.E above, Contractor does not consider that further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract Documents.
- G. Contractor is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Contract Documents.
- H. Contractor has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Contractor has discovered in the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.
- I. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.

ARTICLE 9 – CONTRACT DOCUMENTS

9.01 Contents

- A. The Contract Documents consist of the following:
 - 1. The items listed in the Index to Contract Documents (executed where required), EXCEPT Index items listed in APPENDIX.
 - 2. Addenda
 - 3. Executed Work Change Directives and Change Orders. Change Orders and Change Directives may be delivered or issued on or after the Effective Date of the Agreement.
- B. The Contract Documents may only be amended, modified, or supplemented as provided in Paragraph 3.04 of the General Conditions.

ARTICLE 10 – MISCELLANEOUS

10.01 Terms

- A. Terms used in this Agreement will have the meanings stated in the General Conditions and the Supplementary Conditions.

10.02 Assignment of Contract

- A. No assignment by a party hereto of any rights under or interests in the Contract will be binding on another party hereto without the written consent of the party sought to be bound; and, specifically but without limitation, moneys that may become due and moneys that are due may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by law), and unless specifically stated to the contrary in any written consent to an assignment, no assignment will release or discharge the assignor from any duty or responsibility under the Contract Documents.

10.03 *Successors and Assigns*

- A. Owner and Contractor each binds itself, its partners, successors, assigns, and legal representatives to the other party hereto, its partners, successors, assigns, and legal representatives in respect to all covenants, agreements, and obligations contained in the Contract Documents.

10.04 *Severability*

- A. Any provision or part of the Contract Documents held to be void or unenforceable under any Law or Regulation shall be deemed stricken, and all remaining provisions shall continue to be valid and binding upon Owner and Contractor, who agree that the Contract Documents shall be reformed to replace such stricken provision or part thereof with a valid and enforceable provision that comes as close as possible to expressing the intention of the stricken provision.

10.05 *Contractor's Certifications*

- A. Contractor certifies that it has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for or in executing the Contract. For the purposes of this Paragraph 10.05:
 - 1. "corrupt practice" means the offering, giving, receiving, or soliciting of any thing of value likely to influence the action of a public official in the bidding process or in the Contract execution;
 - 2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process or the execution of the Contract to the detriment of Owner, (b) to establish Bid or Contract prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;
 - 3. "collusive practice" means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish Bid prices at artificial, non-competitive levels; and
 - 4. "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

IN WITNESS WHEREOF, Owner and Contractor have signed this Agreement. Counterparts have been delivered to Owner and Contractor. All portions of the Contract Documents have been signed or have been identified by Owner and Contractor or on their behalf. For Contracts funded in part or in whole by the United States Department of Agriculture Rural Development, Owner and Contractor have signed this Agreement in five (5) parts. One Counterpart has been delivered to Owner, Contractor, Engineer and two Counterparts to the Agency.

This Agreement will be effective on the date last executed below, which is the Effective Date of the Agreement.

OWNER:

CONTRACTOR:

By: _____

By: _____

Title: _____

Title: _____

(If Owner is a corporation, attach evidence of authority to sign).

(If Contractor is a corporation, a partnership, or a joint venture attach evidence of authority to sign.)

Attest: _____

Attest: _____

Title: _____

Title: _____

Address for giving notices:

Address for giving notices:

Date: _____

Contractor License No.: _____

Employer Identification No.:

Date: _____

Note (not a part of this Agreement):

Edits to original EJCDC form C-520 incorporated herein are summarized as follows:

Title and footer - "(Stipulated Price)" is deleted

Article 1 – add in project name, volumes, date

Article 2 – deletes reference to a general description of the Project

Article 4 – states that specific Contract Times and Liquidated Damages are found in Specification Section 01 01 00 and specifies that engineering and inspection costs attributable to delays are in addition to Liquidated Damages.

Article 6 – specifies that 5% retainage is applicable to all payments and release of retainage is subject to satisfaction of applicable state and federal requirements.

Signature page - references number of Agreement counterparts required if funded by USDA RD.

Notice to Proceed

Date: _____

Project: _____

Owner: _____

Contractor: _____

Contractor's Address: [send Certified Mail, Return Receipt Requested]

You are notified that the Contract Times under the above Contract will commence to run on _____. On or before that date, you are to start performing your obligations under the Contract Documents. In accordance with Article 4 of the Agreement, the date of Substantial Completion is _____, and the date of readiness for final payment is __ [(or) the number of days to achieve Substantial Completion is _____, and the number of days to achieve readiness for final payment is _____].

Before you may start any Work at the Site, you must deliver to the Owner certificates of insurance which you are required to purchase and maintain in accordance with the Contract Documents.

Owner

By: _____
Authorized Signature

Title

Date

ACCEPTANCE OF NOTICE

Receipt of the above NOTICE TO PROCEED is hereby acknowledged by _____

Dated this _____ day of _____, 20____.

Title: _____

PERFORMANCE BOND

Any singular reference to Contractor, Surety, Owner, or other party shall be considered plural where applicable.

CONTRACTOR (*Name and Address*): SURETY (*Name, and Address of Principal Place of Business*):

OWNER (*Name and Address*):

CONTRACT

Effective Date of Agreement:
Amount:
Description (*Name and Location*):

BOND

Bond Number:
Date (*Not earlier than Effective Date of Agreement*):
Amount:
Modifications to this Bond Form:

Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Performance Bond to be duly executed by an authorized officer, agent, or representative.

CONTRACTOR AS PRINCIPAL

SURETY

Contractor's Name and Corporate Seal (Seal)

Surety's Name and Corporate Seal (Seal)

By: _____
Signature

By: _____
Signature (Attach Power of Attorney)

Print Name

Print Name

Title

Title

Attest: _____
Signature

Attest: _____
Signature

Title

Title

Note: Provide execution by additional parties, such as joint venturers, if necessary.

Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to Owner for the performance of the Contract, which is incorporated herein by reference.

1. If Contractor performs the Contract, Surety and Contractor have no obligation under this Bond, except to participate in conferences as provided in Paragraph 2.1.
2. If there is no Owner Default, Surety's obligation under this Bond shall arise after:
 - 2.1 Owner has notified Contractor and Surety, at the addresses described in Paragraph 9 below, that Owner is considering declaring a Contractor Default and has requested and attempted to arrange a conference with Contractor and Surety to be held not later than 15 days after receipt of such notice to discuss methods of performing the Contract. If Owner, Contractor, and Surety agree, Contractor shall be allowed a reasonable time to perform the Contract, but such an agreement shall not waive Owner's right, if any, subsequently to declare a Contractor Default; and
 - 2.2 Owner has declared a Contractor Default and formally terminated Contractor's right to complete the Contract. Such Contractor Default shall not be declared earlier than 20 days after Contractor and Surety have received notice as provided in Paragraph 2.1; and
 - 2.3 Owner has agreed to pay the Balance of the Contract Price to:
 1. Surety in accordance with the terms of the Contract; or
 2. Another contractor selected pursuant to Paragraph 3.3 to perform the Contract.
3. When Owner has satisfied the conditions of Paragraph 2, Surety shall promptly, and at Surety's expense, take one of the following actions:
 - 3.1 Arrange for Contractor, with consent of Owner, to perform and complete the Contract; or
 - 3.2 Undertake to perform and complete the Contract itself, through its agents or through independent contractors; or
 - 3.3 Obtain bids or negotiated proposals from qualified contractors acceptable to Owner for a contract for performance and completion of the Contract, arrange for a contract to be prepared for execution by Owner and contractor selected with Owner's concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Contract, and pay to Owner the amount of damages as described in Paragraph 5 in excess of the Balance of the Contract Price incurred by Owner resulting from Contractor Default; or
 - 3.4 Waive its right to perform and complete, arrange for completion, or obtain a new contractor, and with reasonable promptness under the circumstances:
 1. After investigation, determine the amount for which it may be liable to Owner and, as soon as practicable after the amount is determined, tender payment therefor to Owner; or
 2. Deny liability in whole or in part and notify Owner citing reasons therefor.
4. If Surety does not proceed as provided in Paragraph 3 with reasonable promptness, Surety shall be deemed to be in default on this Bond 15 days after receipt of an additional written notice from Owner to Surety demanding that Surety perform its obligations under this Bond, and Owner shall be entitled to enforce any remedy available to Owner. If Surety proceeds as provided in Paragraph 3.4, and Owner refuses the payment tendered or Surety has denied liability, in whole or in part, without further notice Owner shall be entitled to enforce any remedy available to Owner.
5. After Owner has terminated Contractor's right to complete the Contract, and if Surety elects to act under Paragraph 3.1, 3.2, or 3.3 above, then the responsibilities of Surety to Owner shall not be greater than those of Contractor under the Contract, and the responsibilities of Owner to Surety shall not be greater than those of Owner under the Contract. To the limit of the amount of this Bond, but subject to commitment by Owner of the Balance of the Contract Price to mitigation of costs and damages on the Contract, Surety is obligated without duplication for:

- 5.1 The responsibilities of Contractor for correction of defective Work and completion of the Contract;
- 5.2 Additional legal, design professional, and delay costs resulting from Contractor's Default, and resulting from the actions of or failure to act of Surety under Paragraph 3; and
- 5.3 Liquidated damages, or if no liquidated damages are specified in the Contract, actual damages caused by delayed performance or non-performance of Contractor.

6. Surety shall not be liable to Owner or others for obligations of Contractor that are unrelated to the Contract, and the Balance of the Contract Price shall not be reduced or set off on account of any such unrelated obligations. No right of action shall accrue on this Bond to any person or entity other than Owner or its heirs, executors, administrators, or successors.

7. Surety hereby waives notice of any change, including changes of time, to Contract or to related subcontracts, purchase orders, and other obligations.

8. Any proceeding, legal or equitable, under this Bond may be instituted in any court of competent jurisdiction in the location in which the Work or part of the Work is located, and shall be instituted within two years after Contractor Default or within two years after Contractor ceased working or within two years after Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

9. Notice to Surety, Owner, or Contractor shall be mailed or delivered to the address shown on the signature page.

10. When this Bond has been furnished to comply with a statutory requirement in the location where the Contract was to be performed, any provision in this Bond conflicting with said statutory requirement shall be deemed deleted herefrom and provisions conforming to such statutory requirement shall be deemed incorporated herein. The intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

11. Definitions.

- 11.1 Balance of the Contract Price: The total amount payable by Owner to Contractor under the Contract after all proper adjustments have been made, including allowance to Contractor of any amounts received or to be received by Owner in settlement of insurance or other Claims for damages to which Contractor is entitled, reduced by all valid and proper payments made to or on behalf of Contractor under the Contract.
- 11.2 Contract: The agreement between Owner and Contractor identified on the signature page, including all Contract Documents and changes thereto.
- 11.3 Contractor Default: Failure of Contractor, which has neither been remedied nor waived, to perform or otherwise to comply with the terms of the Contract.
- 11.4 Owner Default: Failure of Owner, which has neither been remedied nor waived, to pay Contractor as required by the Contract or to perform and complete or otherwise comply with the other terms thereof.

FOR INFORMATION ONLY – *(Name, Address and Telephone)*

Surety Agency or Broker:

Owner's Representative (*Engineer or other party*): Engineer - Varela & Associates, Inc., 601 W Mallon Ave, Suite A, Spokane, WA 99201 509-328-6066

PAYMENT BOND

Any singular reference to Contractor, Surety, Owner, or other party shall be considered plural where applicable.

CONTRACTOR (*Name and Address*):

SURETY (*Name, and Address of Principal Place of Business*):

OWNER (*Name and Address*):

CONTRACT

Effective Date of Agreement:

Amount:

Description (*Name and Location*):

BOND

Bond Number:

Date (*Not earlier than Effective Date of Agreement*):

Amount:

Modifications to this Bond Form:

Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Payment Bond to be duly executed by an authorized officer, agent, or representative.

CONTRACTOR AS PRINCIPAL

SURETY

Contractor's Name and Corporate Seal (Seal)

Surety's Name and Corporate Seal (Seal)

By: _____
Signature

By: _____
Signature (Attach Power of Attorney)

Print Name

Print Name

Title

Title

Attest: _____
Signature

Attest: _____
Signature

Title

Title

Note: Provide execution by additional parties, such as joint venturers, if necessary.

1. Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to Owner to pay for labor, materials, and equipment furnished by Claimants for use in the performance of the Contract, which is incorporated herein by reference.
2. With respect to Owner, this obligation shall be null and void if Contractor:
 - 2.1 Promptly makes payment, directly or indirectly, for all sums due Claimants, and
 - 2.2 Defends, indemnifies, and holds harmless Owner from all claims, demands, liens, or suits alleging non-payment by Contractor by any person or entity who furnished labor, materials, or equipment for use in the performance of the Contract, provided Owner has promptly notified Contractor and Surety (at the addresses described in Paragraph 12) of any claims, demands, liens, or suits and tendered defense of such claims, demands, liens, or suits to Contractor and Surety, and provided there is no Owner Default.
3. With respect to Claimants, this obligation shall be null and void if Contractor promptly makes payment, directly or indirectly, for all sums due.
4. Surety shall have no obligation to Claimants under this Bond until:
 - 4.1 Claimants who are employed by or have a direct contract with Contractor have given notice to Surety (at the address described in Paragraph 12) and sent a copy, or notice thereof, to Owner, stating that a claim is being made under this Bond and, with substantial accuracy, the amount of the claim.
 - 4.2 Claimants who do not have a direct contract with Contractor:
 1. Have furnished written notice to Contractor and sent a copy, or notice thereof, to Owner, within 90 days after having last performed labor or last furnished materials or equipment included in the claim stating, with substantial accuracy, the amount of the claim and the name of the party to whom the materials or equipment were furnished or supplied, or for whom the labor was done or performed; and
 2. Have either received a rejection in whole or in part from Contractor, or not received within 30 days of furnishing the above notice any communication from Contractor by which Contractor had indicated the claim will be paid directly or indirectly; and
 3. Not having been paid within the above 30 days, have sent a written notice to Surety (at the address described in Paragraph 12) and sent a copy, or notice thereof, to Owner, stating that a claim is being made under this Bond and enclosing a copy of the previous written notice furnished to Contractor.
5. If a notice by a Claimant required by Paragraph 4 is provided by Owner to Contractor or to Surety, that is sufficient compliance.
6. When a Claimant has satisfied the conditions of Paragraph 4, the Surety shall promptly and at Surety's expense take the following actions:
 - 6.1 Send an answer to that Claimant, with a copy to Owner, within 60 days after receipt of the claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed.
 - 6.2 Pay or arrange for payment of any undisputed amounts.
7. Surety's total obligation shall not exceed the amount of this Bond, and the amount of this Bond shall be credited for any payments made in good faith by Surety.
8. Amounts owed by Owner to Contractor under the Contract shall be used for the performance of the Contract and to satisfy claims, if any, under any performance bond. By Contractor furnishing and Owner accepting this Bond, they agree that all funds earned by Contractor in the performance of the Contract are dedicated to satisfy obligations of Contractor and Surety under this Bond, subject to Owner's priority to use the funds for the completion of the Work.

9. Surety shall not be liable to Owner, Claimants, or others for obligations of Contractor that are unrelated to the Contract. Owner shall not be liable for payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligations to make payments to, give notices on behalf of, or otherwise have obligations to Claimants under this Bond.

10. Surety hereby waives notice of any change, including changes of time, to the Contract or to related subcontracts, purchase orders, and other obligations.

11. No suit or action shall be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the location in which the Work or part of the Work is located or after the expiration of one year from the date (1) on which the Claimant gave the notice required by Paragraph 4.1 or Paragraph 4.2.3, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Contract, whichever of (1) or (2) first occurs. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

12. Notice to Surety, Owner, or Contractor shall be mailed or delivered to the addresses shown on the signature page. Actual receipt of notice by Surety, Owner, or Contractor, however accomplished, shall be sufficient compliance as of the date received at the address shown on the signature page.

13. When this Bond has been furnished to comply with a statutory requirement in the location where the Contract was to be performed, any provision in this Bond conflicting with said statutory requirement shall be deemed deleted herefrom and provisions conforming to such statutory requirement shall be deemed incorporated herein. The intent is that this Bond shall be construed as a statutory Bond and not as a common law bond.

14. Upon request of any person or entity appearing to be a potential beneficiary of this Bond, Contractor shall promptly furnish a copy of this Bond or shall permit a copy to be made.

15. Definitions

15.1 Claimant: An individual or entity having a direct contract with Contractor, or with a first-tier subcontractor of Contractor, to furnish labor, materials, or equipment for use in the performance of the Contract. The intent of this Bond shall be to include without limitation in the terms “labor, materials or equipment” that part of water, gas, power, light, heat, oil, gasoline, telephone service, or rental equipment used in the Contract, architectural and engineering services required for performance of the Work of Contractor and Contractor’s subcontractors, and all other items for which a mechanic’s lien may be asserted in the jurisdiction where the labor, materials, or equipment were furnished.

15.2 Contract: The agreement between Owner and Contractor identified on the signature page, including all Contract Documents and changes thereto.

15.3 Owner Default: Failure of Owner, which has neither been remedied nor waived, to pay Contractor as required by the Contract, or to perform and complete or otherwise comply with the other terms thereof.

FOR INFORMATION ONLY – *(Name, Address, and Telephone)*

Surety Agency or Broker:

Owner’s Representative (*Engineer or other party*): Engineer - Varela & Associates, Inc., 601 W Mallon Ave Suite A, Spokane, WA 99201 509-328-6066

STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

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ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

- A. Wherever used in the Bidding Requirements or Contract Documents and printed with initial capital letters, the terms listed below will have the meanings indicated which are applicable to both the singular and plural thereof. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.
1. *Addenda*—Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.
 2. *Agreement*—The written instrument which is evidence of the agreement between Owner and Contractor covering the Work.
 3. *Application for Payment*—The form acceptable to Engineer which is to be used by Contractor during the course of the Work in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.
 4. *Asbestos*—Any material that contains more than one percent asbestos and is friable or is releasing asbestos fibers into the air above current action levels established by the United States Occupational Safety and Health Administration.
 5. *Bid*—The offer or proposal of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.
 6. *Bidder*—The individual or entity who submits a Bid directly to Owner.
 7. *Bidding Documents*—The Bidding Requirements and the proposed Contract Documents (including all Addenda).
 8. *Bidding Requirements*—The advertisement or invitation to bid, Instructions to Bidders, Bid security of acceptable form, if any, and the Bid Form with any supplements.
 9. *Change Order*—A document recommended by Engineer which is signed by Contractor and Owner and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, issued on or after the Effective Date of the Agreement.
 10. *Claim*—A demand or assertion by Owner or Contractor seeking an adjustment of Contract Price or Contract Times, or both, or other relief with respect to the terms of the Contract. A demand for money or services by a third party is not a Claim.
 11. *Contract*—The entire and integrated written agreement between the Owner and Contractor concerning the Work. The Contract supersedes prior negotiations, representations, or agreements, whether written or oral.

12. *Contract Documents*—Those items so designated in the Agreement. Only printed or hard copies of the items listed in the Agreement are Contract Documents. Approved Shop Drawings, other Contractor submittals, and the reports and drawings of subsurface and physical conditions are not Contract Documents.
13. *Contract Price*—The moneys payable by Owner to Contractor for completion of the Work in accordance with the Contract Documents as stated in the Agreement (subject to the provisions of Paragraph 11.03 in the case of Unit Price Work).
14. *Contract Times*—The number of days or the dates stated in the Agreement to: (i) achieve Milestones, if any; (ii) achieve Substantial Completion; and (iii) complete the Work so that it is ready for final payment as evidenced by Engineer's written recommendation of final payment.
15. *Contractor*—The individual or entity with whom Owner has entered into the Agreement.
16. *Cost of the Work*—See Paragraph 11.01 for definition.
17. *Drawings*—That part of the Contract Documents prepared or approved by Engineer which graphically shows the scope, extent, and character of the Work to be performed by Contractor. Shop Drawings and other Contractor submittals are not Drawings as so defined.
18. *Effective Date of the Agreement*—The date indicated in the Agreement on which it becomes effective, but if no such date is indicated, it means the date on which the Agreement is signed and delivered by the last of the two parties to sign and deliver.
19. *Engineer*—The individual or entity named as such in the Agreement.
20. *Field Order*—A written order issued by Engineer which requires minor changes in the Work but which does not involve a change in the Contract Price or the Contract Times.
21. *General Requirements*—Sections of Division 1 of the Specifications.
22. *Hazardous Environmental Condition*—The presence at the Site of Asbestos, PCBs, Petroleum, Hazardous Waste, or Radioactive Material in such quantities or circumstances that may present a substantial danger to persons or property exposed thereto.
23. *Hazardous Waste*—The term Hazardous Waste shall have the meaning provided in Section 1004 of the Solid Waste Disposal Act (42 USC Section 6903) as amended from time to time.
24. *Laws and Regulations; Laws or Regulations*—Any and all applicable laws, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.
25. *Liens*—Charges, security interests, or encumbrances upon Project funds, real property, or personal property.
26. *Milestone*—A principal event specified in the Contract Documents relating to an intermediate completion date or time prior to Substantial Completion of all the Work.

27. *Notice of Award*—The written notice by Owner to the Successful Bidder stating that upon timely compliance by the Successful Bidder with the conditions precedent listed therein, Owner will sign and deliver the Agreement.
28. *Notice to Proceed*—A written notice given by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work under the Contract Documents.
29. *Owner*—The individual or entity with whom Contractor has entered into the Agreement and for whom the Work is to be performed.
30. *PCBs*—Polychlorinated biphenyls.
31. *Petroleum*—Petroleum, including crude oil or any fraction thereof which is liquid at standard conditions of temperature and pressure (60 degrees Fahrenheit and 14.7 pounds per square inch absolute), such as oil, petroleum, fuel oil, oil sludge, oil refuse, gasoline, kerosene, and oil mixed with other non-Hazardous Waste and crude oils.
32. *Progress Schedule*—A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising the Contractor's plan to accomplish the Work within the Contract Times.
33. *Project*—The total construction of which the Work to be performed under the Contract Documents may be the whole, or a part.
34. *Project Manual*—The bound documentary information prepared for bidding and constructing the Work. A listing of the contents of the Project Manual, which may be bound in one or more volumes, is contained in the table(s) of contents.
35. *Radioactive Material*—Source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954 (42 USC Section 2011 et seq.) as amended from time to time.
36. *Resident Project Representative*—The authorized representative of Engineer who may be assigned to the Site or any part thereof.
37. *Samples*—Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and which establish the standards by which such portion of the Work will be judged.
38. *Schedule of Submittals*—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements to support scheduled performance of related construction activities.
39. *Schedule of Values*—A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

40. *Shop Drawings*—All drawings, diagrams, illustrations, schedules, and other data or information which are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work.
41. *Site*—Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements for access thereto, and such other lands furnished by Owner which are designated for the use of Contractor.
42. *Specifications*—That part of the Contract Documents consisting of written requirements for materials, equipment, systems, standards and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable thereto.
43. *Subcontractor*—An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work at the Site.
44. *Substantial Completion*—The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms “substantially complete” and “substantially completed” as applied to all or part of the Work refer to Substantial Completion thereof.
45. *Successful Bidder*—The Bidder submitting a responsive Bid to whom Owner makes an award.
46. *Supplementary Conditions*—That part of the Contract Documents which amends or supplements these General Conditions.
47. *Supplier*—A manufacturer, fabricator, supplier, distributor, materialman, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or Subcontractor.
48. *Underground Facilities*—All underground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities, including those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.
49. *Unit Price Work*—Work to be paid for on the basis of unit prices.
50. *Work*—The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction, and furnishing, installing, and incorporating all materials and equipment into such construction, all as required by the Contract Documents.
51. *Work Change Directive*—A written statement to Contractor issued on or after the Effective Date of the Agreement and signed by Owner and recommended by Engineer ordering an

addition, deletion, or revision in the Work, or responding to differing or unforeseen subsurface or physical conditions under which the Work is to be performed or to emergencies. A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the change ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Times.

1.02 Terminology

A. The words and terms discussed in Paragraph 1.02.B through F are not defined but, when used in the Bidding Requirements or Contract Documents, have the indicated meaning.

B. *Intent of Certain Terms or Adjectives:*

1. The Contract Documents include the terms “as allowed,” “as approved,” “as ordered,” “as directed” or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives “reasonable,” “suitable,” “acceptable,” “proper,” “satisfactory,” or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action, or determination will be solely to evaluate, in general, the Work for compliance with the information in the Contract Documents and with the design concept of the Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility contrary to the provisions of Paragraph 9.09 or any other provision of the Contract Documents.

C. *Day:*

1. The word “day” means a calendar day of 24 hours measured from midnight to the next midnight.

D. *Defective:*

1. The word “defective,” when modifying the word “Work,” refers to Work that is unsatisfactory, faulty, or deficient in that it:
 - a. does not conform to the Contract Documents; or
 - b. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or
 - c. has been damaged prior to Engineer’s recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 14.04 or 14.05).

E. *Furnish, Install, Perform, Provide:*

1. The word “furnish,” when used in connection with services, materials, or equipment, shall mean to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.
2. The word “install,” when used in connection with services, materials, or equipment, shall mean to put into use or place in final position said services, materials, or equipment complete and ready for intended use.
3. The words “perform” or “provide,” when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.
4. When “furnish,” “install,” “perform,” or “provide” is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of Contractor, “provide” is implied.

F. Unless stated otherwise in the Contract Documents, words or phrases that have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

ARTICLE 2 – PRELIMINARY MATTERS

2.01 Delivery of Bonds and Evidence of Insurance

- A. When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner such bonds as Contractor may be required to furnish.
- B. *Evidence of Insurance:* Before any Work at the Site is started, Contractor and Owner shall each deliver to the other, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance which either of them or any additional insured may reasonably request) which Contractor and Owner respectively are required to purchase and maintain in accordance with Article 5.

2.02 Copies of Documents

- A. Owner shall furnish to Contractor up to ten printed or hard copies of the Drawings and Project Manual. Additional copies will be furnished upon request at the cost of reproduction.

2.03 Commencement of Contract Times; Notice to Proceed

- A. The Contract Times will commence to run on the thirtieth day after the Effective Date of the Agreement or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within 30 days after the Effective Date of the Agreement. In no event will the Contract Times commence to run later than the sixtieth day after the day of Bid opening or the thirtieth day after the Effective Date of the Agreement, whichever date is earlier.

2.04 *Starting the Work*

- A. Contractor shall start to perform the Work on the date when the Contract Times commence to run. No Work shall be done at the Site prior to the date on which the Contract Times commence to run.

2.05 *Before Starting Construction*

- A. *Preliminary Schedules:* Within 10 days after the Effective Date of the Agreement (unless otherwise specified in the General Requirements), Contractor shall submit to Engineer for timely review:
 - 1. a preliminary Progress Schedule indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract Documents;
 - 2. a preliminary Schedule of Submittals; and
 - 3. a preliminary Schedule of Values for all of the Work which includes quantities and prices of items which when added together equal the Contract Price and subdivides the Work into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work.

2.06 *Preconstruction Conference; Designation of Authorized Representatives*

- A. Before any Work at the Site is started, a conference attended by Owner, Contractor, Engineer, and others as appropriate will be held to establish a working understanding among the parties as to the Work and to discuss the schedules referred to in Paragraph 2.05.A, procedures for handling Shop Drawings and other submittals, processing Applications for Payment, and maintaining required records.
- B. At this conference Owner and Contractor each shall designate, in writing, a specific individual to act as its authorized representative with respect to the services and responsibilities under the Contract. Such individuals shall have the authority to transmit instructions, receive information, render decisions relative to the Contract, and otherwise act on behalf of each respective party.

2.07 *Initial Acceptance of Schedules*

- A. At least 10 days before submission of the first Application for Payment a conference attended by Contractor, Engineer, and others as appropriate will be held to review for acceptability to Engineer as provided below the schedules submitted in accordance with Paragraph 2.05.A. Contractor shall have an additional 10 days to make corrections and adjustments and to complete and resubmit the schedules. No progress payment shall be made to Contractor until acceptable schedules are submitted to Engineer.
 - 1. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times. Such acceptance will not impose on

Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of the Work, nor interfere with or relieve Contractor from Contractor's full responsibility therefor.

2. Contractor's Schedule of Submittals will be acceptable to Engineer if it provides a workable arrangement for reviewing and processing the required submittals.
3. Contractor's Schedule of Values will be acceptable to Engineer as to form and substance if it provides a reasonable allocation of the Contract Price to component parts of the Work.

ARTICLE 3 – CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE

3.01 *Intent*

- A. The Contract Documents are complementary; what is required by one is as binding as if required by all.
- B. It is the intent of the Contract Documents to describe a functionally complete project (or part thereof) to be constructed in accordance with the Contract Documents. Any labor, documentation, services, materials, or equipment that reasonably may be inferred from the Contract Documents or from prevailing custom or trade usage as being required to produce the indicated result will be provided whether or not specifically called for, at no additional cost to Owner.
- C. Clarifications and interpretations of the Contract Documents shall be issued by Engineer as provided in Article 9.

3.02 *Reference Standards*

- A. Standards, Specifications, Codes, Laws, and Regulations
 1. Reference to standards, specifications, manuals, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, shall mean the standard, specification, manual, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Agreement if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.
 2. No provision of any such standard, specification, manual, or code, or any instruction of a Supplier, shall be effective to change the duties or responsibilities of Owner, Contractor, or Engineer, or any of their subcontractors, consultants, agents, or employees, from those set forth in the Contract Documents. No such provision or instruction shall be effective to assign to Owner, Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the Contract Documents.

3.03 *Reporting and Resolving Discrepancies*

A. *Reporting Discrepancies:*

1. *Contractor's Review of Contract Documents Before Starting Work:* Before undertaking each part of the Work, Contractor shall carefully study and compare the Contract Documents and check and verify pertinent figures therein and all applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy which Contractor discovers, or has actual knowledge of, and shall obtain a written interpretation or clarification from Engineer before proceeding with any Work affected thereby.
2. *Contractor's Review of Contract Documents During Performance of Work:* If, during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents, or between the Contract Documents and (a) any applicable Law or Regulation, (b) any standard, specification, manual, or code, or (c) any instruction of any Supplier, then Contractor shall promptly report it to Engineer in writing. Contractor shall not proceed with the Work affected thereby (except in an emergency as required by Paragraph 6.16.A) until an amendment or supplement to the Contract Documents has been issued by one of the methods indicated in Paragraph 3.04.
3. Contractor shall not be liable to Owner or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Contractor had actual knowledge thereof.

B. *Resolving Discrepancies:*

1. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the Contract Documents shall take precedence in resolving any conflict, error, ambiguity, or discrepancy between the provisions of the Contract Documents and:
 - a. the provisions of any standard, specification, manual, or code, or the instruction of any Supplier (whether or not specifically incorporated by reference in the Contract Documents); or
 - b. the provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

3.04 *Amending and Supplementing Contract Documents*

- A. The Contract Documents may be amended to provide for additions, deletions, and revisions in the Work or to modify the terms and conditions thereof by either a Change Order or a Work Change Directive.
- B. The requirements of the Contract Documents may be supplemented, and minor variations and deviations in the Work may be authorized, by one or more of the following ways:

1. A Field Order;
2. Engineer's approval of a Shop Drawing or Sample (subject to the provisions of Paragraph 6.17.D.3); or
3. Engineer's written interpretation or clarification.

3.05 *Reuse of Documents*

- A. Contractor and any Subcontractor or Supplier shall not:
1. have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or its consultants, including electronic media editions; or
 2. reuse any such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaptation by Engineer.
- B. The prohibitions of this Paragraph 3.05 will survive final payment, or termination of the Contract. Nothing herein shall preclude Contractor from retaining copies of the Contract Documents for record purposes.

3.06 *Electronic Data*

- A. Unless otherwise stated in the Supplementary Conditions, the data furnished by Owner or Engineer to Contractor, or by Contractor to Owner or Engineer, that may be relied upon are limited to the printed copies (also known as hard copies). Files in electronic media format of text, data, graphics, or other types are furnished only for the convenience of the receiving party. Any conclusion or information obtained or derived from such electronic files will be at the user's sole risk. If there is a discrepancy between the electronic files and the hard copies, the hard copies govern.
- B. Because data stored in electronic media format can deteriorate or be modified inadvertently or otherwise without authorization of the data's creator, the party receiving electronic files agrees that it will perform acceptance tests or procedures within 60 days, after which the receiving party shall be deemed to have accepted the data thus transferred. Any errors detected within the 60-day acceptance period will be corrected by the transferring party.
- C. When transferring documents in electronic media format, the transferring party makes no representations as to long term compatibility, usability, or readability of documents resulting from the use of software application packages, operating systems, or computer hardware differing from those used by the data's creator.

**ARTICLE 4 – AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS;
HAZARDOUS ENVIRONMENTAL CONDITIONS; REFERENCE POINTS**

4.01 *Availability of Lands*

- A. Owner shall furnish the Site. Owner shall notify Contractor of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work. Owner will obtain in a timely manner and pay for easements for permanent structures or permanent changes in existing facilities. If Contractor and Owner are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, as a result of any delay in Owner's furnishing the Site or a part thereof, Contractor may make a Claim therefor as provided in Paragraph 10.05.
- B. Upon reasonable written request, Owner shall furnish Contractor with a current statement of record legal title and legal description of the lands upon which the Work is to be performed and Owner's interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.
- C. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

4.02 *Subsurface and Physical Conditions*

- A. *Reports and Drawings:* The Supplementary Conditions identify:
 - 1. those reports known to Owner of explorations and tests of subsurface conditions at or contiguous to the Site; and
 - 2. those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities).
- B. *Limited Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such "technical data" is identified in the Supplementary Conditions. Except for such reliance on such "technical data," Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors with respect to:
 - 1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto; or
 - 2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or
 - 3. any Contractor interpretation of or conclusion drawn from any "technical data" or any such other data, interpretations, opinions, or information.

4.03 *Differing Subsurface or Physical Conditions*

- A. *Notice:* If Contractor believes that any subsurface or physical condition that is uncovered or revealed either:
1. is of such a nature as to establish that any “technical data” on which Contractor is entitled to rely as provided in Paragraph 4.02 is materially inaccurate; or
 2. is of such a nature as to require a change in the Contract Documents; or
 3. differs materially from that shown or indicated in the Contract Documents; or
 4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents;

then Contractor shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency as required by Paragraph 6.16.A), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith (except as aforesaid) until receipt of written order to do so.

- B. *Engineer’s Review:* After receipt of written notice as required by Paragraph 4.03.A, Engineer will promptly review the pertinent condition, determine the necessity of Owner’s obtaining additional exploration or tests with respect thereto, and advise Owner in writing (with a copy to Contractor) of Engineer’s findings and conclusions.

C. *Possible Price and Times Adjustments:*

1. The Contract Price or the Contract Times, or both, will be equitably adjusted to the extent that the existence of such differing subsurface or physical condition causes an increase or decrease in Contractor’s cost of, or time required for, performance of the Work; subject, however, to the following:
 - a. such condition must meet any one or more of the categories described in Paragraph 4.03.A; and
 - b. with respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraphs 9.07 and 11.03.
2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times if:
 - a. Contractor knew of the existence of such conditions at the time Contractor made a final commitment to Owner with respect to Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract; or
 - b. the existence of such condition could reasonably have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and

contiguous areas required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such final commitment; or

- c. Contractor failed to give the written notice as required by Paragraph 4.03.A.
3. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, a Claim may be made therefor as provided in Paragraph 10.05. However, neither Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors shall be liable to Contractor for any claims, costs, losses, or damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Contractor on or in connection with any other project or anticipated project.

4.04 *Underground Facilities*

A. *Shown or Indicated:* The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or contiguous to the Site is based on information and data furnished to Owner or Engineer by the owners of such Underground Facilities, including Owner, or by others. Unless it is otherwise expressly provided in the Supplementary Conditions:

1. Owner and Engineer shall not be responsible for the accuracy or completeness of any such information or data provided by others; and
2. the cost of all of the following will be included in the Contract Price, and Contractor shall have full responsibility for:
 - a. reviewing and checking all such information and data;
 - b. locating all Underground Facilities shown or indicated in the Contract Documents;
 - c. coordination of the Work with the owners of such Underground Facilities, including Owner, during construction; and
 - d. the safety and protection of all such Underground Facilities and repairing any damage thereto resulting from the Work.

B. *Not Shown or Indicated:*

1. If an Underground Facility is uncovered or revealed at or contiguous to the Site which was not shown or indicated, or not shown or indicated with reasonable accuracy in the Contract Documents, Contractor shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by Paragraph 6.16.A), identify the owner of such Underground Facility and give written notice to that owner and to Owner and Engineer. Engineer will promptly review the Underground Facility and determine the extent, if any, to which a change is required in the Contract Documents to reflect and document the

consequences of the existence or location of the Underground Facility. During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.

2. If Engineer concludes that a change in the Contract Documents is required, a Work Change Directive or a Change Order will be issued to reflect and document such consequences. An equitable adjustment shall be made in the Contract Price or Contract Times, or both, to the extent that they are attributable to the existence or location of any Underground Facility that was not shown or indicated or not shown or indicated with reasonable accuracy in the Contract Documents and that Contractor did not know of and could not reasonably have been expected to be aware of or to have anticipated. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment in Contract Price or Contract Times, Owner or Contractor may make a Claim therefor as provided in Paragraph 10.05.

4.05 *Reference Points*

- A. Owner shall provide engineering surveys to establish reference points for construction which in Engineer's judgment are necessary to enable Contractor to proceed with the Work. Contractor shall be responsible for laying out the Work, shall protect and preserve the established reference points and property monuments, and shall make no changes or relocations without the prior written approval of Owner. Contractor shall report to Engineer whenever any reference point or property monument is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points or property monuments by professionally qualified personnel.

4.06 *Hazardous Environmental Condition at Site*

- A. *Reports and Drawings:* The Supplementary Conditions identify those reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at the Site.
- B. *Limited Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such "technical data" is identified in the Supplementary Conditions. Except for such reliance on such "technical data," Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors with respect to:
 1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures of construction to be employed by Contractor and safety precautions and programs incident thereto; or
 2. other data, interpretations, opinions and information contained in such reports or shown or indicated in such drawings; or
 3. any Contractor interpretation of or conclusion drawn from any "technical data" or any such other data, interpretations, opinions or information.

- C. Contractor shall not be responsible for any Hazardous Environmental Condition uncovered or revealed at the Site which was not shown or indicated in Drawings or Specifications or identified in the Contract Documents to be within the scope of the Work. Contractor shall be responsible for a Hazardous Environmental Condition created with any materials brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible.
- D. If Contractor encounters a Hazardous Environmental Condition or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, Contractor shall immediately: (i) secure or otherwise isolate such condition; (ii) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 6.16.A); and (iii) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any. Promptly after consulting with Engineer, Owner shall take such actions as are necessary to permit Owner to timely obtain required permits and provide Contractor the written notice required by Paragraph 4.06.E.
- E. Contractor shall not be required to resume Work in connection with such condition or in any affected area until after Owner has obtained any required permits related thereto and delivered written notice to Contractor: (i) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work; or (ii) specifying any special conditions under which such Work may be resumed safely. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, or both, as a result of such Work stoppage or such special conditions under which Work is agreed to be resumed by Contractor, either party may make a Claim therefor as provided in Paragraph 10.05.
- F. If after receipt of such written notice Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special conditions, then Owner may order the portion of the Work that is in the area affected by such condition to be deleted from the Work. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of an adjustment in Contract Price or Contract Times as a result of deleting such portion of the Work, then either party may make a Claim therefor as provided in Paragraph 10.05. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 7.
- G. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition: (i) was not shown or indicated in the Drawings or Specifications or identified in the Contract Documents to be included within the scope of the Work, and (ii) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 4.06.G shall obligate Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

- H. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 4.06.H shall obligate Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.
- I. The provisions of Paragraphs 4.02, 4.03, and 4.04 do not apply to a Hazardous Environmental Condition uncovered or revealed at the Site.

ARTICLE 5 – BONDS AND INSURANCE

5.01 *Performance, Payment, and Other Bonds*

- A. Contractor shall furnish performance and payment bonds, each in an amount at least equal to the Contract Price as security for the faithful performance and payment of all of Contractor's obligations under the Contract Documents. These bonds shall remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 13.07, whichever is later, except as provided otherwise by Laws or Regulations or by the Contract Documents. Contractor shall also furnish such other bonds as are required by the Contract Documents.
- B. All bonds shall be in the form prescribed by the Contract Documents except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in the list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (amended) by the Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury. All bonds signed by an agent or attorney-in-fact must be accompanied by a certified copy of that individual's authority to bind the surety. The evidence of authority shall show that it is effective on the date the agent or attorney-in-fact signed each bond.
- C. If the surety on any bond furnished by Contractor is declared bankrupt or becomes insolvent or its right to do business is terminated in any state where any part of the Project is located or it ceases to meet the requirements of Paragraph 5.01.B, Contractor shall promptly notify Owner and Engineer and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which shall comply with the requirements of Paragraphs 5.01.B and 5.02.

5.02 *Licensed Sureties and Insurers*

- A. All bonds and insurance required by the Contract Documents to be purchased and maintained by Owner or Contractor shall be obtained from surety or insurance companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue bonds or insurance policies for the limits and coverages so required. Such surety and insurance companies shall also

meet such additional requirements and qualifications as may be provided in the Supplementary Conditions.

5.03 *Certificates of Insurance*

- A. Contractor shall deliver to Owner, with copies to each additional insured and loss payee identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by Owner or any other additional insured) which Contractor is required to purchase and maintain.
- B. Owner shall deliver to Contractor, with copies to each additional insured and loss payee identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by Contractor or any other additional insured) which Owner is required to purchase and maintain.
- C. Failure of Owner to demand such certificates or other evidence of Contractor's full compliance with these insurance requirements or failure of Owner to identify a deficiency in compliance from the evidence provided shall not be construed as a waiver of Contractor's obligation to maintain such insurance.
- D. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor.
- E. The insurance and insurance limits required herein shall not be deemed as a limitation on Contractor's liability under the indemnities granted to Owner in the Contract Documents.

5.04 *Contractor's Insurance*

- A. Contractor shall purchase and maintain such insurance as is appropriate for the Work being performed and as will provide protection from claims set forth below which may arise out of or result from Contractor's performance of the Work and Contractor's other obligations under the Contract Documents, whether it is to be performed by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable:
 - 1. claims under workers' compensation, disability benefits, and other similar employee benefit acts;
 - 2. claims for damages because of bodily injury, occupational sickness or disease, or death of Contractor's employees;
 - 3. claims for damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees;
 - 4. claims for damages insured by reasonably available personal injury liability coverage which are sustained:

- a. by any person as a result of an offense directly or indirectly related to the employment of such person by Contractor, or
 - b. by any other person for any other reason;
5. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom; and
 6. claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance or use of any motor vehicle.
- B. The policies of insurance required by this Paragraph 5.04 shall:
1. with respect to insurance required by Paragraphs 5.04.A.3 through 5.04.A.6 inclusive, be written on an occurrence basis, include as additional insureds (subject to any customary exclusion regarding professional liability) Owner and Engineer, and any other individuals or entities identified in the Supplementary Conditions, all of whom shall be listed as additional insureds, and include coverage for the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of all such additional insureds, and the insurance afforded to these additional insureds shall provide primary coverage for all claims covered thereby;
 2. include at least the specific coverages and be written for not less than the limits of liability provided in the Supplementary Conditions or required by Laws or Regulations, whichever is greater;
 3. include contractual liability insurance covering Contractor's indemnity obligations under Paragraphs 6.11 and 6.20;
 4. contain a provision or endorsement that the coverage afforded will not be canceled, materially changed or renewal refused until at least 30 days prior written notice has been given to Owner and Contractor and to each other additional insured identified in the Supplementary Conditions to whom a certificate of insurance has been issued (and the certificates of insurance furnished by the Contractor pursuant to Paragraph 5.03 will so provide);
 5. remain in effect at least until final payment and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work in accordance with Paragraph 13.07; and
 6. include completed operations coverage:
 - a. Such insurance shall remain in effect for two years after final payment.
 - b. Contractor shall furnish Owner and each other additional insured identified in the Supplementary Conditions, to whom a certificate of insurance has been issued, evidence satisfactory to Owner and any such additional insured of continuation of such insurance at final payment and one year thereafter.

5.05 *Owner's Liability Insurance*

- A. In addition to the insurance required to be provided by Contractor under Paragraph 5.04, Owner, at Owner's option, may purchase and maintain at Owner's expense Owner's own liability insurance as will protect Owner against claims which may arise from operations under the Contract Documents.

5.06 *Property Insurance*

- A. Unless otherwise provided in the Supplementary Conditions, Owner shall purchase and maintain property insurance upon the Work at the Site in the amount of the full replacement cost thereof (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). This insurance shall:
1. include the interests of Owner, Contractor, Subcontractors, and Engineer, and any other individuals or entities identified in the Supplementary Conditions, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as a loss payee;
 2. be written on a Builder's Risk "all-risk" policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, falsework, and materials and equipment in transit, and shall insure against at least the following perils or causes of loss: fire, lightning, extended coverage, theft, vandalism and malicious mischief, earthquake, collapse, debris removal, demolition occasioned by enforcement of Laws and Regulations, water damage (other than that caused by flood), and such other perils or causes of loss as may be specifically required by the Supplementary Conditions.
 3. include expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects);
 4. cover materials and equipment stored at the Site or at another location that was agreed to in writing by Owner prior to being incorporated in the Work, provided that such materials and equipment have been included in an Application for Payment recommended by Engineer;
 5. allow for partial utilization of the Work by Owner;
 6. include testing and startup; and
 7. be maintained in effect until final payment is made unless otherwise agreed to in writing by Owner, Contractor, and Engineer with 30 days written notice to each other loss payee to whom a certificate of insurance has been issued.
- B. Owner shall purchase and maintain such equipment breakdown insurance or additional property insurance as may be required by the Supplementary Conditions or Laws and Regulations which will include the interests of Owner, Contractor, Subcontractors, and Engineer, and any other individuals or entities identified in the Supplementary Conditions, and the officers, directors,

members, partners, employees, agents, consultants and subcontractors of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as a loss payee.

- C. All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with this Paragraph 5.06 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until at least 30 days prior written notice has been given to Owner and Contractor and to each other loss payee to whom a certificate of insurance has been issued and will contain waiver provisions in accordance with Paragraph 5.07.
- D. Owner shall not be responsible for purchasing and maintaining any property insurance specified in this Paragraph 5.06 to protect the interests of Contractor, Subcontractors, or others in the Work to the extent of any deductible amounts that are identified in the Supplementary Conditions. The risk of loss within such identified deductible amount will be borne by Contractor, Subcontractors, or others suffering any such loss, and if any of them wishes property insurance coverage within the limits of such amounts, each may purchase and maintain it at the purchaser's own expense.
- E. If Contractor requests in writing that other special insurance be included in the property insurance policies provided under this Paragraph 5.06, Owner shall, if possible, include such insurance, and the cost thereof will be charged to Contractor by appropriate Change Order. Prior to commencement of the Work at the Site, Owner shall in writing advise Contractor whether or not such other insurance has been procured by Owner.

5.07 *Waiver of Rights*

- A. Owner and Contractor intend that all policies purchased in accordance with Paragraph 5.06 will protect Owner, Contractor, Subcontractors, and Engineer, and all other individuals or entities identified in the Supplementary Conditions as loss payees (and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them) in such policies and will provide primary coverage for all losses and damages caused by the perils or causes of loss covered thereby. All such policies shall contain provisions to the effect that in the event of payment of any loss or damage the insurers will have no rights of recovery against any of the insureds or loss payees thereunder. Owner and Contractor waive all rights against each other and their respective officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them for all losses and damages caused by, arising out of or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Subcontractors and Engineer, and all other individuals or entities identified in the Supplementary Conditions as loss payees (and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them) under such policies for losses and damages so caused. None of the above waivers shall extend to the rights that any party making such waiver may have to the proceeds of insurance held by Owner as trustee or otherwise payable under any policy so issued.
- B. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them for:

1. loss due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to Owner's property or the Work caused by, arising out of, or resulting from fire or other perils whether or not insured by Owner; and
 2. loss or damage to the completed Project or part thereof caused by, arising out of, or resulting from fire or other insured peril or cause of loss covered by any property insurance maintained on the completed Project or part thereof by Owner during partial utilization pursuant to Paragraph 14.05, after Substantial Completion pursuant to Paragraph 14.04, or after final payment pursuant to Paragraph 14.07.
- C. Any insurance policy maintained by Owner covering any loss, damage or consequential loss referred to in Paragraph 5.07.B shall contain provisions to the effect that in the event of payment of any such loss, damage, or consequential loss, the insurers will have no rights of recovery against Contractor, Subcontractors, or Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them.

5.08 *Receipt and Application of Insurance Proceeds*

- A. Any insured loss under the policies of insurance required by Paragraph 5.06 will be adjusted with Owner and made payable to Owner as fiduciary for the loss payees, as their interests may appear, subject to the requirements of any applicable mortgage clause and of Paragraph 5.08.B. Owner shall deposit in a separate account any money so received and shall distribute it in accordance with such agreement as the parties in interest may reach. If no other special agreement is reached, the damaged Work shall be repaired or replaced, the moneys so received applied on account thereof, and the Work and the cost thereof covered by an appropriate Change Order.
- B. Owner as fiduciary shall have power to adjust and settle any loss with the insurers unless one of the parties in interest shall object in writing within 15 days after the occurrence of loss to Owner's exercise of this power. If such objection be made, Owner as fiduciary shall make settlement with the insurers in accordance with such agreement as the parties in interest may reach. If no such agreement among the parties in interest is reached, Owner as fiduciary shall adjust and settle the loss with the insurers and, if required in writing by any party in interest, Owner as fiduciary shall give bond for the proper performance of such duties.

5.09 *Acceptance of Bonds and Insurance; Option to Replace*

- A. If either Owner or Contractor has any objection to the coverage afforded by or other provisions of the bonds or insurance required to be purchased and maintained by the other party in accordance with Article 5 on the basis of non-conformance with the Contract Documents, the objecting party shall so notify the other party in writing within 10 days after receipt of the certificates (or other evidence requested) required by Paragraph 2.01.B. Owner and Contractor shall each provide to the other such additional information in respect of insurance provided as the other may reasonably request. If either party does not purchase or maintain all of the bonds and insurance required of such party by the Contract Documents, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage. Without prejudice to any other right or remedy, the other party may elect to obtain equivalent bonds or insurance to protect such other party's

interests at the expense of the party who was required to provide such coverage, and a Change Order shall be issued to adjust the Contract Price accordingly.

5.10 *Partial Utilization, Acknowledgment of Property Insurer*

- A. If Owner finds it necessary to occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work as provided in Paragraph 14.05, no such use or occupancy shall commence before the insurers providing the property insurance pursuant to Paragraph 5.06 have acknowledged notice thereof and in writing effected any changes in coverage necessitated thereby. The insurers providing the property insurance shall consent by endorsement on the policy or policies, but the property insurance shall not be canceled or permitted to lapse on account of any such partial use or occupancy.

ARTICLE 6 – CONTRACTOR’S RESPONSIBILITIES

6.01 *Supervision and Superintendence*

- A. Contractor shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction. Contractor shall not be responsible for the negligence of Owner or Engineer in the design or specification of a specific means, method, technique, sequence, or procedure of construction which is shown or indicated in and expressly required by the Contract Documents.
- B. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who shall not be replaced without written notice to Owner and Engineer except under extraordinary circumstances.

6.02 *Labor; Working Hours*

- A. Contractor shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. Contractor shall at all times maintain good discipline and order at the Site.
- B. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site shall be performed during regular working hours. Contractor will not permit the performance of Work on a Saturday, Sunday, or any legal holiday without Owner’s written consent (which will not be unreasonably withheld) given after prior written notice to Engineer.

6.03 *Services, Materials, and Equipment*

- A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start-up, and completion of the Work.

- B. All materials and equipment incorporated into the Work shall be as specified or, if not specified, shall be of good quality and new, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications shall expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.
- C. All materials and equipment shall be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

6.04 *Progress Schedule*

- A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.07 as it may be adjusted from time to time as provided below.
 - 1. Contractor shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.07) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times. Such adjustments will comply with any provisions of the General Requirements applicable thereto.
 - 2. Proposed adjustments in the Progress Schedule that will change the Contract Times shall be submitted in accordance with the requirements of Article 12. Adjustments in Contract Times may only be made by a Change Order.

6.05 *Substitutes and "Or-Equals"*

- A. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the specification or description is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or-equal" item or no substitution is permitted, other items of material or equipment or material or equipment of other Suppliers may be submitted to Engineer for review under the circumstances described below.
 - 1. "*Or-Equal*" Items: If in Engineer's sole discretion an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, it may be considered by Engineer as an "or-equal" item, in which case review and approval of the proposed item may, in Engineer's sole discretion, be accomplished without compliance with some or all of the requirements for approval of proposed substitute items. For the purposes of this Paragraph 6.05.A.1, a proposed item of material or equipment will be considered functionally equal to an item so named if:
 - a. in the exercise of reasonable judgment Engineer determines that:
 - 1) it is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;

- 2) it will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole; and
 - 3) it has a proven record of performance and availability of responsive service.
- b. Contractor certifies that, if approved and incorporated into the Work:
- 1) there will be no increase in cost to the Owner or increase in Contract Times; and
 - 2) it will conform substantially to the detailed requirements of the item named in the Contract Documents.

2. *Substitute Items:*

- a. If in Engineer's sole discretion an item of material or equipment proposed by Contractor does not qualify as an "or-equal" item under Paragraph 6.05.A.1, it will be considered a proposed substitute item.
- b. Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is essentially equivalent to that named and an acceptable substitute therefor. Requests for review of proposed substitute items of material or equipment will not be accepted by Engineer from anyone other than Contractor.
- c. The requirements for review by Engineer will be as set forth in Paragraph 6.05.A.2.d, as supplemented by the General Requirements, and as Engineer may decide is appropriate under the circumstances.
- d. Contractor shall make written application to Engineer for review of a proposed substitute item of material or equipment that Contractor seeks to furnish or use. The application:
 - 1) shall certify that the proposed substitute item will:
 - a) perform adequately the functions and achieve the results called for by the general design,
 - b) be similar in substance to that specified, and
 - c) be suited to the same use as that specified;
 - 2) will state:
 - a) the extent, if any, to which the use of the proposed substitute item will prejudice Contractor's achievement of Substantial Completion on time,
 - b) whether use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item, and

- c) whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty;
 - 3) will identify:
 - a) all variations of the proposed substitute item from that specified, and
 - b) available engineering, sales, maintenance, repair, and replacement services; and
 - 4) shall contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including costs of redesign and claims of other contractors affected by any resulting change.
- B. *Substitute Construction Methods or Procedures:* If a specific means, method, technique, sequence, or procedure of construction is expressly required by the Contract Documents, Contractor may furnish or utilize a substitute means, method, technique, sequence, or procedure of construction approved by Engineer. Contractor shall submit sufficient information to allow Engineer, in Engineer's sole discretion, to determine that the substitute proposed is equivalent to that expressly called for by the Contract Documents. The requirements for review by Engineer will be similar to those provided in Paragraph 6.05.A.2.
- C. *Engineer's Evaluation:* Engineer will be allowed a reasonable time within which to evaluate each proposal or submittal made pursuant to Paragraphs 6.05.A and 6.05.B. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No "or equal" or substitute will be ordered, installed or utilized until Engineer's review is complete, which will be evidenced by a Change Order in the case of a substitute and an approved Shop Drawing for an "or equal." Engineer will advise Contractor in writing of any negative determination.
- D. *Special Guarantee:* Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.
- E. *Engineer's Cost Reimbursement:* Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor pursuant to Paragraphs 6.05.A.2 and 6.05.B. Whether or not Engineer approves a substitute so proposed or submitted by Contractor, Contractor shall reimburse Owner for the reasonable charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the reasonable charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.
- F. *Contractor's Expense:* Contractor shall provide all data in support of any proposed substitute or "or-equal" at Contractor's expense.

6.06 *Concerning Subcontractors, Suppliers, and Others*

- A. Contractor shall not employ any Subcontractor, Supplier, or other individual or entity (including those acceptable to Owner as indicated in Paragraph 6.06.B), whether initially or as a replacement, against whom Owner may have reasonable objection. Contractor shall not be

required to employ any Subcontractor, Supplier, or other individual or entity to furnish or perform any of the Work against whom Contractor has reasonable objection.

- B. If the Supplementary Conditions require the identity of certain Subcontractors, Suppliers, or other individuals or entities to be submitted to Owner in advance for acceptance by Owner by a specified date prior to the Effective Date of the Agreement, and if Contractor has submitted a list thereof in accordance with the Supplementary Conditions, Owner's acceptance (either in writing or by failing to make written objection thereto by the date indicated for acceptance or objection in the Bidding Documents or the Contract Documents) of any such Subcontractor, Supplier, or other individual or entity so identified may be revoked on the basis of reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity, and the Contract Price will be adjusted by the difference in the cost occasioned by such replacement, and an appropriate Change Order will be issued. No acceptance by Owner of any such Subcontractor, Supplier, or other individual or entity, whether initially or as a replacement, shall constitute a waiver of any right of Owner or Engineer to reject defective Work.
- C. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of the Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work just as Contractor is responsible for Contractor's own acts and omissions. Nothing in the Contract Documents:
1. shall create for the benefit of any such Subcontractor, Supplier, or other individual or entity any contractual relationship between Owner or Engineer and any such Subcontractor, Supplier or other individual or entity; nor
 2. shall create any obligation on the part of Owner or Engineer to pay or to see to the payment of any moneys due any such Subcontractor, Supplier, or other individual or entity except as may otherwise be required by Laws and Regulations.
- D. Contractor shall be solely responsible for scheduling and coordinating the Work of Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work under a direct or indirect contract with Contractor.
- E. Contractor shall require all Subcontractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work to communicate with Engineer through Contractor.
- F. The divisions and sections of the Specifications and the identifications of any Drawings shall not control Contractor in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.
- G. All Work performed for Contractor by a Subcontractor or Supplier will be pursuant to an appropriate agreement between Contractor and the Subcontractor or Supplier which specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of Owner and Engineer. Whenever any such agreement is with a Subcontractor or Supplier who is listed as a loss payee on the property insurance provided in Paragraph 5.06, the agreement between the Contractor and the Subcontractor or Supplier will contain provisions whereby the Subcontractor or Supplier waives all rights against Owner,

Contractor, Engineer, and all other individuals or entities identified in the Supplementary Conditions to be listed as insureds or loss payees (and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them) for all losses and damages caused by, arising out of, relating to, or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work. If the insurers on any such policies require separate waiver forms to be signed by any Subcontractor or Supplier, Contractor will obtain the same.

6.07 *Patent Fees and Royalties*

- A. Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product, or device is specified in the Contract Documents for use in the performance of the Work and if, to the actual knowledge of Owner or Engineer, its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by Owner in the Contract Documents.
- B. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, and its officers, directors, members, partners, employees, agents, consultants, and subcontractors from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device specified in the Contract Documents, but not identified as being subject to payment of any license fee or royalty to others required by patent rights or copyrights.
- C. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.

6.08 *Permits*

- A. Unless otherwise provided in the Supplementary Conditions, Contractor shall obtain and pay for all construction permits and licenses. Owner shall assist Contractor, when necessary, in obtaining such permits and licenses. Contractor shall pay all governmental charges and inspection fees necessary for the prosecution of the Work which are applicable at the time of opening of Bids, or, if there are no Bids, on the Effective Date of the Agreement. Owner shall pay all charges of utility owners for connections for providing permanent service to the Work.

6.09 *Laws and Regulations*

- A. Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.
- B. If Contractor performs any Work knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work. However, it shall not be Contractor's responsibility to make certain that the Specifications and Drawings are in accordance with Laws and Regulations, but this shall not relieve Contractor of Contractor's obligations under Paragraph 3.03.
- C. Changes in Laws or Regulations not known at the time of opening of Bids (or, on the Effective Date of the Agreement if there were no Bids) having an effect on the cost or time of performance of the Work shall be the subject of an adjustment in Contract Price or Contract Times. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made therefor as provided in Paragraph 10.05.

6.10 *Taxes*

- A. Contractor shall pay all sales, consumer, use, and other similar taxes required to be paid by Contractor in accordance with the Laws and Regulations of the place of the Project which are applicable during the performance of the Work.

6.11 *Use of Site and Other Areas*

A. *Limitation on Use of Site and Other Areas:*

1. Contractor shall confine construction equipment, the storage of materials and equipment, and the operations of workers to the Site and other areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and other areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for any damage to any such land or area, or to the owner or occupant thereof, or of any adjacent land or areas resulting from the performance of the Work.
2. Should any claim be made by any such owner or occupant because of the performance of the Work, Contractor shall promptly settle with such other party by negotiation or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law.
3. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought

by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused by or based upon Contractor's performance of the Work.

- B. *Removal of Debris During Performance of the Work:* During the progress of the Work Contractor shall keep the Site and other areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris shall conform to applicable Laws and Regulations.
- C. *Cleaning:* Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work Contractor shall remove from the Site all tools, appliances, construction equipment and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.
- D. *Loading Structures:* Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall Contractor subject any part of the Work or adjacent property to stresses or pressures that will endanger it.

6.12 *Record Documents*

- A. Contractor shall maintain in a safe place at the Site one record copy of all Drawings, Specifications, Addenda, Change Orders, Work Change Directives, Field Orders, and written interpretations and clarifications in good order and annotated to show changes made during construction. These record documents together with all approved Samples and a counterpart of all approved Shop Drawings will be available to Engineer for reference. Upon completion of the Work, these record documents, Samples, and Shop Drawings will be delivered to Engineer for Owner.

6.13 *Safety and Protection*

- A. Contractor shall be solely responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. Such responsibility does not relieve Subcontractors of their responsibility for the safety of persons or property in the performance of their work, nor for compliance with applicable safety Laws and Regulations. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to:
 - 1. all persons on the Site or who may be affected by the Work;
 - 2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and
 - 3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.
- B. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and

shall erect and maintain all necessary safeguards for such safety and protection. Contractor shall notify owners of adjacent property and of Underground Facilities and other utility owners when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property.

- C. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. The Supplementary Conditions identify any Owner's safety programs that are applicable to the Work.
- D. Contractor shall inform Owner and Engineer of the specific requirements of Contractor's safety program with which Owner's and Engineer's employees and representatives must comply while at the Site.
- E. All damage, injury, or loss to any property referred to in Paragraph 6.13.A.2 or 6.13.A.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).
- F. Contractor's duties and responsibilities for safety and for protection of the Work shall continue until such time as all the Work is completed and Engineer has issued a notice to Owner and Contractor in accordance with Paragraph 14.07.B that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).

6.14 *Safety Representative*

- A. Contractor shall designate a qualified and experienced safety representative at the Site whose duties and responsibilities shall be the prevention of accidents and the maintaining and supervising of safety precautions and programs.

6.15 *Hazard Communication Programs*

- A. Contractor shall be responsible for coordinating any exchange of material safety data sheets or other hazard communication information required to be made available to or exchanged between or among employers at the Site in accordance with Laws or Regulations.

6.16 *Emergencies*

- A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, Contractor is obligated to act to prevent threatened damage, injury, or loss. Contractor shall give Engineer prompt written notice if Contractor believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby or are required as a result thereof. If Engineer determines that a change in the Contract Documents is

required because of the action taken by Contractor in response to such an emergency, a Work Change Directive or Change Order will be issued.

6.17 *Shop Drawings and Samples*

A. Contractor shall submit Shop Drawings and Samples to Engineer for review and approval in accordance with the accepted Schedule of Submittals (as required by Paragraph 2.07). Each submittal will be identified as Engineer may require.

1. *Shop Drawings:*

- a. Submit number of copies specified in the General Requirements.
- b. Data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to provide and to enable Engineer to review the information for the limited purposes required by Paragraph 6.17.D.

2. *Samples:*

- a. Submit number of Samples specified in the Specifications.
- b. Clearly identify each Sample as to material, Supplier, pertinent data such as catalog numbers, the use for which intended and other data as Engineer may require to enable Engineer to review the submittal for the limited purposes required by Paragraph 6.17.D.

B. Where a Shop Drawing or Sample is required by the Contract Documents or the Schedule of Submittals, any related Work performed prior to Engineer's review and approval of the pertinent submittal will be at the sole expense and responsibility of Contractor.

C. *Submittal Procedures:*

1. Before submitting each Shop Drawing or Sample, Contractor shall have:

- a. reviewed and coordinated each Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;
- b. determined and verified all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;
- c. determined and verified the suitability of all materials offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and
- d. determined and verified all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto.

2. Each submittal shall bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review and approval of that submittal.
3. With each submittal, Contractor shall give Engineer specific written notice of any variations that the Shop Drawing or Sample may have from the requirements of the Contract Documents. This notice shall be both a written communication separate from the Shop Drawings or Sample submittal; and, in addition, by a specific notation made on each Shop Drawing or Sample submitted to Engineer for review and approval of each such variation.

D. *Engineer's Review:*

1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the Schedule of Submittals acceptable to Engineer. Engineer's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.
2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction (except where a particular means, method, technique, sequence, or procedure of construction is specifically and expressly called for by the Contract Documents) or to safety precautions or programs incident thereto. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.
3. Engineer's review and approval shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 6.17.C.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer's review and approval shall not relieve Contractor from responsibility for complying with the requirements of Paragraph 6.17.C.1.

E. *Resubmittal Procedures:*

1. Contractor shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review and approval. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous submittals.

6.18 *Continuing the Work*

- A. Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with Owner. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, except as permitted by Paragraph 15.04 or as Owner and Contractor may otherwise agree in writing.

6.19 *Contractor's General Warranty and Guarantee*

- A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer and its officers, directors, members, partners, employees, agents, consultants, and subcontractors shall be entitled to rely on representation of Contractor's warranty and guarantee.
- B. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:
 - 1. abuse, modification, or improper maintenance or operation by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or
 - 2. normal wear and tear under normal usage.
- C. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of Contractor's obligation to perform the Work in accordance with the Contract Documents:
 - 1. observations by Engineer;
 - 2. recommendation by Engineer or payment by Owner of any progress or final payment;
 - 3. the issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner;
 - 4. use or occupancy of the Work or any part thereof by Owner;
 - 5. any review and approval of a Shop Drawing or Sample submittal or the issuance of a notice of acceptability by Engineer;
 - 6. any inspection, test, or approval by others; or
 - 7. any correction of defective Work by Owner.

6.20 *Indemnification*

- A. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the performance of the Work, provided that any such claim, cost, loss, or damage is attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom but only to the extent caused by any negligent act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work or anyone for whose acts any of them may be liable .

- B. In any and all claims against Owner or Engineer or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 6.20.A shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.
- C. The indemnification obligations of Contractor under Paragraph 6.20.A shall not extend to the liability of Engineer and Engineer's officers, directors, members, partners, employees, agents, consultants and subcontractors arising out of:
 - 1. the preparation or approval of, or the failure to prepare or approve maps, Drawings, opinions, reports, surveys, Change Orders, designs, or Specifications; or
 - 2. giving directions or instructions, or failing to give them, if that is the primary cause of the injury or damage.

6.21 *Delegation of Professional Design Services*

- A. Contractor will not be required to provide professional design services unless such services are specifically required by the Contract Documents for a portion of the Work or unless such services are required to carry out Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. Contractor shall not be required to provide professional services in violation of applicable law.
- B. If professional design services or certifications by a design professional related to systems, materials or equipment are specifically required of Contractor by the Contract Documents, Owner and Engineer will specify all performance and design criteria that such services must satisfy. Contractor shall cause such services or certifications to be provided by a properly licensed professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings and other submittals prepared by such professional. Shop Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to Engineer.
- C. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy and completeness of the services, certifications or approvals performed by such design professionals, provided Owner and Engineer have specified to Contractor all performance and design criteria that such services must satisfy.
- D. Pursuant to this Paragraph 6.21, Engineer's review and approval of design calculations and design drawings will be only for the limited purpose of checking for conformance with performance and design criteria given and the design concept expressed in the Contract Documents. Engineer's review and approval of Shop Drawings and other submittals (except design calculations and design drawings) will be only for the purpose stated in Paragraph 6.17.D.1.

- E. Contractor shall not be responsible for the adequacy of the performance or design criteria required by the Contract Documents.

ARTICLE 7 – OTHER WORK AT THE SITE

7.01 Related Work at Site

- A. Owner may perform other work related to the Project at the Site with Owner’s employees, or through other direct contracts therefor, or have other work performed by utility owners. If such other work is not noted in the Contract Documents, then:
 - 1. written notice thereof will be given to Contractor prior to starting any such other work; and
 - 2. if Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times that should be allowed as a result of such other work, a Claim may be made therefor as provided in Paragraph 10.05.
- B. Contractor shall afford each other contractor who is a party to such a direct contract, each utility owner, and Owner, if Owner is performing other work with Owner’s employees, proper and safe access to the Site, provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work, and properly coordinate the Work with theirs. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering such work; provided, however, that Contractor may cut or alter others' work with the written consent of Engineer and the others whose work will be affected. The duties and responsibilities of Contractor under this Paragraph are for the benefit of such utility owners and other contractors to the extent that there are comparable provisions for the benefit of Contractor in said direct contracts between Owner and such utility owners and other contractors.
- C. If the proper execution or results of any part of Contractor’s Work depends upon work performed by others under this Article 7, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor’s Work. Contractor’s failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor’s Work except for latent defects and deficiencies in such other work.

7.02 Coordination

- A. If Owner intends to contract with others for the performance of other work on the Project at the Site, the following will be set forth in Supplementary Conditions:
 - 1. the individual or entity who will have authority and responsibility for coordination of the activities among the various contractors will be identified;
 - 2. the specific matters to be covered by such authority and responsibility will be itemized; and
 - 3. the extent of such authority and responsibilities will be provided.

- B. Unless otherwise provided in the Supplementary Conditions, Owner shall have sole authority and responsibility for such coordination.

7.03 *Legal Relationships*

- A. Paragraphs 7.01.A and 7.02 are not applicable for utilities not under the control of Owner.
- B. Each other direct contract of Owner under Paragraph 7.01.A shall provide that the other contractor is liable to Owner and Contractor for the reasonable direct delay and disruption costs incurred by Contractor as a result of the other contractor's wrongful actions or inactions.
- C. Contractor shall be liable to Owner and any other contractor under direct contract to Owner for the reasonable direct delay and disruption costs incurred by such other contractor as a result of Contractor's wrongful action or inactions.

ARTICLE 8 – OWNER'S RESPONSIBILITIES

8.01 *Communications to Contractor*

- A. Except as otherwise provided in these General Conditions, Owner shall issue all communications to Contractor through Engineer.

8.02 *Replacement of Engineer*

- A. In case of termination of the employment of Engineer, Owner shall appoint an engineer to whom Contractor makes no reasonable objection, whose status under the Contract Documents shall be that of the former Engineer.

8.03 *Furnish Data*

- A. Owner shall promptly furnish the data required of Owner under the Contract Documents.

8.04 *Pay When Due*

- A. Owner shall make payments to Contractor when they are due as provided in Paragraphs 14.02.C and 14.07.C.

8.05 *Lands and Easements; Reports and Tests*

- A. Owner's duties with respect to providing lands and easements and providing engineering surveys to establish reference points are set forth in Paragraphs 4.01 and 4.05. Paragraph 4.02 refers to Owner's identifying and making available to Contractor copies of reports of explorations and tests of subsurface conditions and drawings of physical conditions relating to existing surface or subsurface structures at the Site.

8.06 *Insurance*

- A. Owner's responsibilities, if any, with respect to purchasing and maintaining liability and property insurance are set forth in Article 5.

8.07 *Change Orders*

A. Owner is obligated to execute Change Orders as indicated in Paragraph 10.03.

8.08 *Inspections, Tests, and Approvals*

A. Owner's responsibility with respect to certain inspections, tests, and approvals is set forth in Paragraph 13.03.B.

8.09 *Limitations on Owner's Responsibilities*

A. The Owner shall not supervise, direct, or have control or authority over, nor be responsible for, Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Owner will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

8.10 *Undisclosed Hazardous Environmental Condition*

A. Owner's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 4.06.

8.11 *Evidence of Financial Arrangements*

A. Upon request of Contractor, Owner shall furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract Documents.

8.12 *Compliance with Safety Program*

A. While at the Site, Owner's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Owner has been informed pursuant to Paragraph 6.13.D.

ARTICLE 9 – ENGINEER'S STATUS DURING CONSTRUCTION

9.01 *Owner's Representative*

A. Engineer will be Owner's representative during the construction period. The duties and responsibilities and the limitations of authority of Engineer as Owner's representative during construction are set forth in the Contract Documents.

9.02 *Visits to Site*

A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Engineer deems necessary in order to observe as an experienced and qualified design professional the progress that has been made and the quality of the various aspects of Contractor's executed Work. Based on information obtained during such visits and observations, Engineer, for the benefit of Owner, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or

continuous inspections on the Site to check the quality or quantity of the Work. Engineer's efforts will be directed toward providing for Owner a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.

- B. Engineer's visits and observations are subject to all the limitations on Engineer's authority and responsibility set forth in Paragraph 9.09. Particularly, but without limitation, during or as a result of Engineer's visits or observations of Contractor's Work, Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work.

9.03 *Project Representative*

- A. If Owner and Engineer agree, Engineer will furnish a Resident Project Representative to assist Engineer in providing more extensive observation of the Work. The authority and responsibilities of any such Resident Project Representative and assistants will be as provided in the Supplementary Conditions, and limitations on the responsibilities thereof will be as provided in Paragraph 9.09. If Owner designates another representative or agent to represent Owner at the Site who is not Engineer's consultant, agent or employee, the responsibilities and authority and limitations thereon of such other individual or entity will be as provided in the Supplementary Conditions.

9.04 *Authorized Variations in Work*

- A. Engineer may authorize minor variations in the Work from the requirements of the Contract Documents which do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. These may be accomplished by a Field Order and will be binding on Owner and also on Contractor, who shall perform the Work involved promptly. If Owner or Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, or both, and the parties are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made therefor as provided in Paragraph 10.05.

9.05 *Rejecting Defective Work*

- A. Engineer will have authority to reject Work which Engineer believes to be defective, or that Engineer believes will not produce a completed Project that conforms to the Contract Documents or that will prejudice the integrity of the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Engineer will also have authority to require special inspection or testing of the Work as provided in Paragraph 13.04, whether or not the Work is fabricated, installed, or completed.

9.06 *Shop Drawings, Change Orders and Payments*

- A. In connection with Engineer's authority, and limitations thereof, as to Shop Drawings and Samples, see Paragraph 6.17.
- B. In connection with Engineer's authority, and limitations thereof, as to design calculations and design drawings submitted in response to a delegation of professional design services, if any, see Paragraph 6.21.
- C. In connection with Engineer's authority as to Change Orders, see Articles 10, 11, and 12.
- D. In connection with Engineer's authority as to Applications for Payment, see Article 14.

9.07 *Determinations for Unit Price Work*

- A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the Engineer's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). Engineer's written decision thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, subject to the provisions of Paragraph 10.05.

9.08 *Decisions on Requirements of Contract Documents and Acceptability of Work*

- A. Engineer will be the initial interpreter of the requirements of the Contract Documents and judge of the acceptability of the Work thereunder. All matters in question and other matters between Owner and Contractor arising prior to the date final payment is due relating to the acceptability of the Work, and the interpretation of the requirements of the Contract Documents pertaining to the performance of the Work, will be referred initially to Engineer in writing within 30 days of the event giving rise to the question.
- B. Engineer will, with reasonable promptness, render a written decision on the issue referred. If Owner or Contractor believes that any such decision entitles them to an adjustment in the Contract Price or Contract Times or both, a Claim may be made under Paragraph 10.05. The date of Engineer's decision shall be the date of the event giving rise to the issues referenced for the purposes of Paragraph 10.05.B.
- C. Engineer's written decision on the issue referred will be final and binding on Owner and Contractor, subject to the provisions of Paragraph 10.05.
- D. When functioning as interpreter and judge under this Paragraph 9.08, Engineer will not show partiality to Owner or Contractor and will not be liable in connection with any interpretation or decision rendered in good faith in such capacity.

9.09 *Limitations on Engineer's Authority and Responsibilities*

- A. Neither Engineer's authority or responsibility under this Article 9 or under any other provision of the Contract Documents nor any decision made by Engineer in good faith either to exercise or not

exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Engineer shall create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.

- B. Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.
- C. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.
- D. Engineer's review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Paragraph 14.07.A will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals that the results certified indicate compliance with, the Contract Documents.
- E. The limitations upon authority and responsibility set forth in this Paragraph 9.09 shall also apply to the Resident Project Representative, if any, and assistants, if any.

9.10 *Compliance with Safety Program*

- A. While at the Site, Engineer's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Engineer has been informed pursuant to Paragraph 6.13.D.

ARTICLE 10 – CHANGES IN THE WORK; CLAIMS

10.01 *Authorized Changes in the Work*

- A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work by a Change Order, or a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved which will be performed under the applicable conditions of the Contract Documents (except as otherwise specifically provided).
- B. If Owner and Contractor are unable to agree on entitlement to, or on the amount or extent, if any, of an adjustment in the Contract Price or Contract Times, or both, that should be allowed as a result of a Work Change Directive, a Claim may be made therefor as provided in Paragraph 10.05.

10.02 *Unauthorized Changes in the Work*

- A. Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents as amended, modified, or supplemented as provided in Paragraph 3.04, except in the case of an emergency as provided in Paragraph 6.16 or in the case of uncovering Work as provided in Paragraph 13.04.D.

10.03 *Execution of Change Orders*

- A. Owner and Contractor shall execute appropriate Change Orders recommended by Engineer covering:
 - 1. changes in the Work which are: (i) ordered by Owner pursuant to Paragraph 10.01.A, (ii) required because of acceptance of defective Work under Paragraph 13.08.A or Owner's correction of defective Work under Paragraph 13.09, or (iii) agreed to by the parties;
 - 2. changes in the Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive; and
 - 3. changes in the Contract Price or Contract Times which embody the substance of any written decision rendered by Engineer pursuant to Paragraph 10.05; provided that, in lieu of executing any such Change Order, an appeal may be taken from any such decision in accordance with the provisions of the Contract Documents and applicable Laws and Regulations, but during any such appeal, Contractor shall carry on the Work and adhere to the Progress Schedule as provided in Paragraph 6.18.A.

10.04 *Notification to Surety*

- A. If the provisions of any bond require notice to be given to a surety of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times), the giving of any such notice will be Contractor's responsibility. The amount of each applicable bond will be adjusted to reflect the effect of any such change.

10.05 *Claims*

- A. *Engineer's Decision Required:* All Claims, except those waived pursuant to Paragraph 14.09, shall be referred to the Engineer for decision. A decision by Engineer shall be required as a condition precedent to any exercise by Owner or Contractor of any rights or remedies either may otherwise have under the Contract Documents or by Laws and Regulations in respect of such Claims.
- B. *Notice:* Written notice stating the general nature of each Claim shall be delivered by the claimant to Engineer and the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto. The responsibility to substantiate a Claim shall rest with the party making the Claim. Notice of the amount or extent of the Claim, with supporting data

shall be delivered to the Engineer and the other party to the Contract within 60 days after the start of such event (unless Engineer allows additional time for claimant to submit additional or more accurate data in support of such Claim). A Claim for an adjustment in Contract Price shall be prepared in accordance with the provisions of Paragraph 12.01.B. A Claim for an adjustment in Contract Times shall be prepared in accordance with the provisions of Paragraph 12.02.B. Each Claim shall be accompanied by claimant's written statement that the adjustment claimed is the entire adjustment to which the claimant believes it is entitled as a result of said event. The opposing party shall submit any response to Engineer and the claimant within 30 days after receipt of the claimant's last submittal (unless Engineer allows additional time).

- C. *Engineer's Action:* Engineer will review each Claim and, within 30 days after receipt of the last submittal of the claimant or the last submittal of the opposing party, if any, take one of the following actions in writing:
1. deny the Claim in whole or in part;
 2. approve the Claim; or
 3. notify the parties that the Engineer is unable to resolve the Claim if, in the Engineer's sole discretion, it would be inappropriate for the Engineer to do so. For purposes of further resolution of the Claim, such notice shall be deemed a denial.
- D. In the event that Engineer does not take action on a Claim within said 30 days, the Claim shall be deemed denied.
- E. Engineer's written action under Paragraph 10.05.C or denial pursuant to Paragraphs 10.05.C.3 or 10.05.D will be final and binding upon Owner and Contractor, unless Owner or Contractor invoke the dispute resolution procedure set forth in Article 16 within 30 days of such action or denial.
- F. No Claim for an adjustment in Contract Price or Contract Times will be valid if not submitted in accordance with this Paragraph 10.05.

ARTICLE 11 – COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

11.01 Cost of the Work

- A. *Costs Included:* The term Cost of the Work means the sum of all costs, except those excluded in Paragraph 11.01.B, necessarily incurred and paid by Contractor in the proper performance of the Work. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, the costs to be reimbursed to Contractor will be only those additional or incremental costs required because of the change in the Work or because of the event giving rise to the Claim. Except as otherwise may be agreed to in writing by Owner, such costs shall be in amounts no higher than those prevailing in the locality of the Project, shall not include any of the costs itemized in Paragraph 11.01.B, and shall include only the following items:

1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor. Such employees shall include, without limitation, superintendents, foremen, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, bonuses, sick leave, vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, shall be included in the above to the extent authorized by Owner.
2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts shall accrue to Owner. All trade discounts, rebates and refunds and returns from sale of surplus materials and equipment shall accrue to Owner, and Contractor shall make provisions so that they may be obtained.
3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, who will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee shall be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 11.01.
4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed for services specifically related to the Work.
5. Supplemental costs including the following:
 - a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.
 - b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.
 - c. Rentals of all construction equipment and machinery, and the parts thereof whether rented from Contractor or others in accordance with rental agreements approved by Owner with the advice of Engineer, and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs shall be in accordance with the terms of

said rental agreements. The rental of any such equipment, machinery, or parts shall cease when the use thereof is no longer necessary for the Work.

- d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, as imposed by Laws and Regulations.
- e. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.
- f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of property insurance established in accordance with Paragraph 5.06.D), provided such losses and damages have resulted from causes other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses shall be included in the Cost of the Work for the purpose of determining Contractor's fee.
- g. The cost of utilities, fuel, and sanitary facilities at the Site.
- h. Minor expenses such as telegrams, long distance telephone calls, telephone service at the Site, express and courier services, and similar petty cash items in connection with the Work.
- i. The costs of premiums for all bonds and insurance Contractor is required by the Contract Documents to purchase and maintain.

B. *Costs Excluded:* The term Cost of the Work shall not include any of the following items:

1. Payroll costs and other compensation of Contractor's officers, executives, principals (of partnerships and sole proprietorships), general managers, safety managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expeditors, timekeepers, clerks, and other personnel employed by Contractor, whether at the Site or in Contractor's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in Paragraph 11.01.A.1 or specifically covered by Paragraph 11.01.A.4, all of which are to be considered administrative costs covered by the Contractor's fee.
2. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.
3. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.
4. Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not

limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.

5. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraphs 11.01.A.
- C. *Contractor's Fee:* When all the Work is performed on the basis of cost-plus, Contractor's fee shall be determined as set forth in the Agreement. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, Contractor's fee shall be determined as set forth in Paragraph 12.01.C.
- D. *Documentation:* Whenever the Cost of the Work for any purpose is to be determined pursuant to Paragraphs 11.01.A and 11.01.B, Contractor will establish and maintain records thereof in accordance with generally accepted accounting practices and submit in a form acceptable to Engineer an itemized cost breakdown together with supporting data.

11.02 Allowances

- A. It is understood that Contractor has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be performed for such sums and by such persons or entities as may be acceptable to Owner and Engineer.
- B. *Cash Allowances:*
 1. Contractor agrees that:
 - a. the cash allowances include the cost to Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and
 - b. Contractor's costs for unloading and handling on the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment on account of any of the foregoing will be valid.
- C. *Contingency Allowance:*
 1. Contractor agrees that a contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.
- D. Prior to final payment, an appropriate Change Order will be issued as recommended by Engineer to reflect actual amounts due Contractor on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.

11.03 Unit Price Work

- A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to

the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.

- B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Determinations of the actual quantities and classifications of Unit Price Work performed by Contractor will be made by Engineer subject to the provisions of Paragraph 9.07.
- C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.
- D. Owner or Contractor may make a Claim for an adjustment in the Contract Price in accordance with Paragraph 10.05 if:
 - 1. the quantity of any item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement; and
 - 2. there is no corresponding adjustment with respect to any other item of Work; and
 - 3. Contractor believes that Contractor is entitled to an increase in Contract Price as a result of having incurred additional expense or Owner believes that Owner is entitled to a decrease in Contract Price and the parties are unable to agree as to the amount of any such increase or decrease.

ARTICLE 12 – CHANGE OF CONTRACT PRICE; CHANGE OF CONTRACT TIMES

12.01 Change of Contract Price

- A. The Contract Price may only be changed by a Change Order. Any Claim for an adjustment in the Contract Price shall be based on written notice submitted by the party making the Claim to the Engineer and the other party to the Contract in accordance with the provisions of Paragraph 10.05.
- B. The value of any Work covered by a Change Order or of any Claim for an adjustment in the Contract Price will be determined as follows:
 - 1. where the Work involved is covered by unit prices contained in the Contract Documents, by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 11.03); or
 - 2. where the Work involved is not covered by unit prices contained in the Contract Documents, by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 12.01.C.2); or
 - 3. where the Work involved is not covered by unit prices contained in the Contract Documents and agreement to a lump sum is not reached under Paragraph 12.01.B.2, on the basis of the Cost of the Work (determined as provided in Paragraph 11.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 12.01.C).

C. *Contractor's Fee*: The Contractor's fee for overhead and profit shall be determined as follows:

1. a mutually acceptable fixed fee; or
2. if a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:
 - a. for costs incurred under Paragraphs 11.01.A.1 and 11.01.A.2, the Contractor's fee shall be 15 percent;
 - b. for costs incurred under Paragraph 11.01.A.3, the Contractor's fee shall be five percent;
 - c. where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraphs 12.01.C.2.a and 12.01.C.2.b is that the Subcontractor who actually performs the Work, at whatever tier, will be paid a fee of 15 percent of the costs incurred by such Subcontractor under Paragraphs 11.01.A.1 and 11.01.A.2 and that any higher tier Subcontractor and Contractor will each be paid a fee of five percent of the amount paid to the next lower tier Subcontractor;
 - d. no fee shall be payable on the basis of costs itemized under Paragraphs 11.01.A.4, 11.01.A.5, and 11.01.B;
 - e. the amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in cost will be the amount of the actual net decrease in cost plus a deduction in Contractor's fee by an amount equal to five percent of such net decrease; and
 - f. when both additions and credits are involved in any one change, the adjustment in Contractor's fee shall be computed on the basis of the net change in accordance with Paragraphs 12.01.C.2.a through 12.01.C.2.e, inclusive.

12.02 *Change of Contract Times*

- A. The Contract Times may only be changed by a Change Order. Any Claim for an adjustment in the Contract Times shall be based on written notice submitted by the party making the Claim to the Engineer and the other party to the Contract in accordance with the provisions of Paragraph 10.05.
- B. Any adjustment of the Contract Times covered by a Change Order or any Claim for an adjustment in the Contract Times will be determined in accordance with the provisions of this Article 12.

12.03 *Delays*

- A. Where Contractor is prevented from completing any part of the Work within the Contract Times due to delay beyond the control of Contractor, the Contract Times will be extended in an amount equal to the time lost due to such delay if a Claim is made therefor as provided in Paragraph 12.02.A. Delays beyond the control of Contractor shall include, but not be limited to, acts or

neglect by Owner, acts or neglect of utility owners or other contractors performing other work as contemplated by Article 7, fires, floods, epidemics, abnormal weather conditions, or acts of God.

- B. If Owner, Engineer, or other contractors or utility owners performing other work for Owner as contemplated by Article 7, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times, or both. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.
- C. If Contractor is delayed in the performance or progress of the Work by fire, flood, epidemic, abnormal weather conditions, acts of God, acts or failures to act of utility owners not under the control of Owner, or other causes not the fault of and beyond control of Owner and Contractor, then Contractor shall be entitled to an equitable adjustment in Contract Times, if such adjustment is essential to Contractor's ability to complete the Work within the Contract Times. Such an adjustment shall be Contractor's sole and exclusive remedy for the delays described in this Paragraph 12.03.C.
- D. Owner, Engineer, and their officers, directors, members, partners, employees, agents, consultants, or subcontractors shall not be liable to Contractor for any claims, costs, losses, or damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Contractor on or in connection with any other project or anticipated project.
- E. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delays within the control of Contractor. Delays attributable to and within the control of a Subcontractor or Supplier shall be deemed to be delays within the control of Contractor.

ARTICLE 13 – TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

13.01 Notice of Defects

- A. Prompt notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor. Defective Work may be rejected, corrected, or accepted as provided in this Article 13.

13.02 Access to Work

- A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and governmental agencies with jurisdictional interests will have access to the Site and the Work at reasonable times for their observation, inspection, and testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's safety procedures and programs so that they may comply therewith as applicable.

13.03 *Tests and Inspections*

- A. Contractor shall give Engineer timely notice of readiness of the Work for all required inspections, tests, or approvals and shall cooperate with inspection and testing personnel to facilitate required inspections or tests.
- B. Owner shall employ and pay for the services of an independent testing laboratory to perform all inspections, tests, or approvals required by the Contract Documents except:
 - 1. for inspections, tests, or approvals covered by Paragraphs 13.03.C and 13.03.D below;
 - 2. that costs incurred in connection with tests or inspections conducted pursuant to Paragraph 13.04.B shall be paid as provided in Paragraph 13.04.C; and
 - 3. as otherwise specifically provided in the Contract Documents.
- C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.
- D. Contractor shall be responsible for arranging and obtaining and shall pay all costs in connection with any inspections, tests, or approvals required for Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work; or acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work. Such inspections, tests, or approvals shall be performed by organizations acceptable to Owner and Engineer.
- E. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, Contractor shall, if requested by Engineer, uncover such Work for observation.
- F. Uncovering Work as provided in Paragraph 13.03.E shall be at Contractor's expense unless Contractor has given Engineer timely notice of Contractor's intention to cover the same and Engineer has not acted with reasonable promptness in response to such notice.

13.04 *Uncovering Work*

- A. If any Work is covered contrary to the written request of Engineer, it must, if requested by Engineer, be uncovered for Engineer's observation and replaced at Contractor's expense.
- B. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, Contractor, at Engineer's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as Engineer may require, that portion of the Work in question, furnishing all necessary labor, material, and equipment.

- C. If it is found that the uncovered Work is defective, Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and Owner shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount thereof, Owner may make a Claim therefor as provided in Paragraph 10.05.
- D. If the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, Contractor may make a Claim therefor as provided in Paragraph 10.05.

13.05 *Owner May Stop the Work*

- A. If the Work is defective, or Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to perform the Work in such a way that the completed Work will conform to the Contract Documents, Owner may order Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of Owner to stop the Work shall not give rise to any duty on the part of Owner to exercise this right for the benefit of Contractor, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

13.06 *Correction or Removal of Defective Work*

- A. Promptly after receipt of written notice, Contractor shall correct all defective Work, whether or not fabricated, installed, or completed, or, if the Work has been rejected by Engineer, remove it from the Project and replace it with Work that is not defective. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or removal (including but not limited to all costs of repair or replacement of work of others).
- B. When correcting defective Work under the terms of this Paragraph 13.06 or Paragraph 13.07, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.

13.07 *Correction Period*

- A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the terms of any applicable special guarantee required by the Contract Documents) or by any specific provision of the Contract Documents, any Work is found to be defective, or if the repair of any damages to the land or areas made available for Contractor's use by Owner or permitted by Laws and Regulations as contemplated in Paragraph 6.11.A is found to be defective, Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:

1. repair such defective land or areas; or
 2. correct such defective Work; or
 3. if the defective Work has been rejected by Owner, remove it from the Project and replace it with Work that is not defective, and
 4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others or other land or areas resulting therefrom.
- B. If Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. All claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others) will be paid by Contractor.
- C. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications.
- D. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this Paragraph 13.07, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.
- E. Contractor's obligations under this Paragraph 13.07 are in addition to any other obligation or warranty. The provisions of this Paragraph 13.07 shall not be construed as a substitute for, or a waiver of, the provisions of any applicable statute of limitation or repose.

13.08 *Acceptance of Defective Work*

- A. If, instead of requiring correction or removal and replacement of defective Work, Owner (and, prior to Engineer's recommendation of final payment, Engineer) prefers to accept it, Owner may do so. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) attributable to Owner's evaluation of and determination to accept such defective Work (such costs to be approved by Engineer as to reasonableness) and for the diminished value of the Work to the extent not otherwise paid by Contractor pursuant to this sentence. If any such acceptance occurs prior to Engineer's recommendation of final payment, a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work, and Owner shall be entitled to an appropriate decrease in the Contract Price, reflecting the diminished value of Work so accepted. If the parties are unable to agree as to the amount thereof, Owner may make a Claim therefor as provided in Paragraph 10.05. If the acceptance occurs after such recommendation, an appropriate amount will be paid by Contractor to Owner.

13.09 *Owner May Correct Defective Work*

- A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work, or to remove and replace rejected Work as required by Engineer in accordance with Paragraph 13.06.A, or if Contractor fails to perform the Work in accordance with the Contract Documents, or if Contractor fails to comply with any other provision of the Contract Documents, Owner may, after seven days written notice to Contractor, correct, or remedy any such deficiency.
- B. In exercising the rights and remedies under this Paragraph 13.09, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, take possession of Contractor's tools, appliances, construction equipment and machinery at the Site, and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this Paragraph.
- C. All claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 13.09 will be charged against Contractor, and a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and Owner shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount of the adjustment, Owner may make a Claim therefor as provided in Paragraph 10.05. Such claims, costs, losses and damages will include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor's defective Work.
- D. Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this Paragraph 13.09.

ARTICLE 14 – PAYMENTS TO CONTRACTOR AND COMPLETION

14.01 *Schedule of Values*

- A. The Schedule of Values established as provided in Paragraph 2.07.A will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments on account of Unit Price Work will be based on the number of units completed.

14.02 *Progress Payments*

A. *Applications for Payments:*

- 1. At least 20 days before the date established in the Agreement for each progress payment (but not more often than once a month), Contractor shall submit to Engineer for review an

Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment shall also be accompanied by a bill of sale, invoice, or other documentation warranting that Owner has received the materials and equipment free and clear of all Liens and evidence that the materials and equipment are covered by appropriate property insurance or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.

2. Beginning with the second Application for Payment, each Application shall include an affidavit of Contractor stating that all previous progress payments received on account of the Work have been applied on account to discharge Contractor's legitimate obligations associated with prior Applications for Payment.
3. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.

B. *Review of Applications:*

1. Engineer will, within 10 days after receipt of each Application for Payment, either indicate in writing a recommendation of payment and present the Application to Owner or return the Application to Contractor indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.
2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations of the executed Work as an experienced and qualified design professional, and on Engineer's review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:
 - a. the Work has progressed to the point indicated;
 - b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, the results of any subsequent tests called for in the Contract Documents, a final determination of quantities and classifications for Unit Price Work under Paragraph 9.07, and any other qualifications stated in the recommendation); and
 - c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.
3. By recommending any such payment Engineer will not thereby be deemed to have represented that:
 - a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or

- involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract Documents; or
- b. there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.
4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:
 - a. to supervise, direct, or control the Work, or
 - b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or
 - c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work, or
 - d. to make any examination to ascertain how or for what purposes Contractor has used the moneys paid on account of the Contract Price, or
 - e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.
 5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 14.02.B.2. Engineer may also refuse to recommend any such payment or, because of subsequently discovered evidence or the results of subsequent inspections or tests, revise or revoke any such payment recommendation previously made, to such extent as may be necessary in Engineer's opinion to protect Owner from loss because:
 - a. the Work is defective, or completed Work has been damaged, requiring correction or replacement;
 - b. the Contract Price has been reduced by Change Orders;
 - c. Owner has been required to correct defective Work or complete Work in accordance with Paragraph 13.09; or
 - d. Engineer has actual knowledge of the occurrence of any of the events enumerated in Paragraph 15.02.A.

C. Payment Becomes Due:

1. Ten days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended will (subject to the provisions of Paragraph 14.02.D) become due, and when due will be paid by Owner to Contractor.

D. *Reduction in Payment:*

1. Owner may refuse to make payment of the full amount recommended by Engineer because:
 - a. claims have been made against Owner on account of Contractor's performance or furnishing of the Work;
 - b. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens;
 - c. there are other items entitling Owner to a set-off against the amount recommended; or
 - d. Owner has actual knowledge of the occurrence of any of the events enumerated in Paragraphs 14.02.B.5.a through 14.02.B.5.c or Paragraph 15.02.A.
2. If Owner refuses to make payment of the full amount recommended by Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and promptly pay Contractor any amount remaining after deduction of the amount so withheld. Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, when Contractor remedies the reasons for such action.
3. Upon a subsequent determination that Owner's refusal of payment was not justified, the amount wrongfully withheld shall be treated as an amount due as determined by Paragraph 14.02.C.1 and subject to interest as provided in the Agreement.

14.03 *Contractor's Warranty of Title*

- A. Contractor warrants and guarantees that title to all Work, materials, and equipment covered by any Application for Payment, whether incorporated in the Project or not, will pass to Owner no later than the time of payment free and clear of all Liens.

14.04 *Substantial Completion*

- A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete (except for items specifically listed by Contractor as incomplete) and request that Engineer issue a certificate of Substantial Completion.
- B. Promptly after Contractor's notification, Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.
- C. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a tentative certificate of Substantial Completion which shall fix the date of Substantial Completion. There shall be attached to the certificate a tentative list of items to be completed or corrected before

final payment. Owner shall have seven days after receipt of the tentative certificate during which to make written objection to Engineer as to any provisions of the certificate or attached list. If, after considering such objections, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of the tentative certificate to Owner, notify Contractor in writing, stating the reasons therefor. If, after consideration of Owner's objections, Engineer considers the Work substantially complete, Engineer will, within said 14 days, execute and deliver to Owner and Contractor a definitive certificate of Substantial Completion (with a revised tentative list of items to be completed or corrected) reflecting such changes from the tentative certificate as Engineer believes justified after consideration of any objections from Owner.

- D. At the time of delivery of the tentative certificate of Substantial Completion, Engineer will deliver to Owner and Contractor a written recommendation as to division of responsibilities pending final payment between Owner and Contractor with respect to security, operation, safety, and protection of the Work, maintenance, heat, utilities, insurance, and warranties and guarantees. Unless Owner and Contractor agree otherwise in writing and so inform Engineer in writing prior to Engineer's issuing the definitive certificate of Substantial Completion, Engineer's aforesaid recommendation will be binding on Owner and Contractor until final payment.
- E. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to remove its property and complete or correct items on the tentative list.

14.05 *Partial Utilization*

- A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by Owner for its intended purpose without significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions:
 - 1. Owner at any time may request Contractor in writing to permit Owner to use or occupy any such part of the Work which Owner believes to be ready for its intended use and substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor, Owner, and Engineer will follow the procedures of Paragraph 14.04.A through D for that part of the Work.
 - 2. Contractor at any time may notify Owner and Engineer in writing that Contractor considers any such part of the Work ready for its intended use and substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.
 - 3. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 14.04 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.

4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 5.10 regarding property insurance.

14.06 *Final Inspection*

- A. Upon written notice from Contractor that the entire Work or an agreed portion thereof is complete, Engineer will promptly make a final inspection with Owner and Contractor and will notify Contractor in writing of all particulars in which this inspection reveals that the Work is incomplete or defective. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

14.07 *Final Payment*

A. *Application for Payment:*

1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance, certificates of inspection, marked-up record documents (as provided in Paragraph 6.12), and other documents, Contractor may make application for final payment following the procedure for progress payments.
2. The final Application for Payment shall be accompanied (except as previously delivered) by:
 - a. all documentation called for in the Contract Documents, including but not limited to the evidence of insurance required by Paragraph 5.04.B.6;
 - b. consent of the surety, if any, to final payment;
 - c. a list of all Claims against Owner that Contractor believes are unsettled; and
 - d. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of or Liens filed in connection with the Work.
3. In lieu of the releases or waivers of Liens specified in Paragraph 14.07.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (i) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (ii) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner might in any way be responsible, or which might in any way result in liens or other burdens on Owner's property, have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien.

B. *Engineer's Review of Application and Acceptance:*

1. If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying

documentation as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract Documents have been fulfilled, Engineer will, within ten days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of payment and present the Application for Payment to Owner for payment. At the same time Engineer will also give written notice to Owner and Contractor that the Work is acceptable subject to the provisions of Paragraph 14.09. Otherwise, Engineer will return the Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application for Payment.

C. *Payment Becomes Due:*

1. Thirty days after the presentation to Owner of the Application for Payment and accompanying documentation, the amount recommended by Engineer, less any sum Owner is entitled to set off against Engineer's recommendation, including but not limited to liquidated damages, will become due and will be paid by Owner to Contractor.

14.08 *Final Completion Delayed*

- A. If, through no fault of Contractor, final completion of the Work is significantly delayed, and if Engineer so confirms, Owner shall, upon receipt of Contractor's final Application for Payment (for Work fully completed and accepted) and recommendation of Engineer, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance to be held by Owner for Work not fully completed or corrected is less than the retainage stipulated in the Agreement, and if bonds have been furnished as required in Paragraph 5.01, the written consent of the surety to the payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by Contractor to Engineer with the Application for such payment. Such payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.

14.09 *Waiver of Claims*

- A. The making and acceptance of final payment will constitute:
 1. a waiver of all Claims by Owner against Contractor, except Claims arising from unsettled Liens, from defective Work appearing after final inspection pursuant to Paragraph 14.06, from failure to comply with the Contract Documents or the terms of any special guarantees specified therein, or from Contractor's continuing obligations under the Contract Documents; and
 2. a waiver of all Claims by Contractor against Owner other than those previously made in accordance with the requirements herein and expressly acknowledged by Owner in writing as still unsettled.

ARTICLE 15 – SUSPENSION OF WORK AND TERMINATION

15.01 *Owner May Suspend Work*

- A. At any time and without cause, Owner may suspend the Work or any portion thereof for a period of not more than 90 consecutive days by notice in writing to Contractor and Engineer which will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be granted an adjustment in the Contract Price or an extension of the Contract Times, or both, directly attributable to any such suspension if Contractor makes a Claim therefor as provided in Paragraph 10.05.

15.02 *Owner May Terminate for Cause*

- A. The occurrence of any one or more of the following events will justify termination for cause:
1. Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the Progress Schedule established under Paragraph 2.07 as adjusted from time to time pursuant to Paragraph 6.04);
 2. Contractor's disregard of Laws or Regulations of any public body having jurisdiction;
 3. Contractor's repeated disregard of the authority of Engineer; or
 4. Contractor's violation in any substantial way of any provisions of the Contract Documents.
- B. If one or more of the events identified in Paragraph 15.02.A occur, Owner may, after giving Contractor (and surety) seven days written notice of its intent to terminate the services of Contractor:
1. exclude Contractor from the Site, and take possession of the Work and of all Contractor's tools, appliances, construction equipment, and machinery at the Site, and use the same to the full extent they could be used by Contractor (without liability to Contractor for trespass or conversion);
 2. incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere; and
 3. complete the Work as Owner may deem expedient.
- C. If Owner proceeds as provided in Paragraph 15.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Owner arising out of or relating to completing the Work, such excess will be paid to Contractor. If such claims, costs, losses, and damages exceed such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their reasonableness and, when

so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this Paragraph, Owner shall not be required to obtain the lowest price for the Work performed.

- D. Notwithstanding Paragraphs 15.02.B and 15.02.C, Contractor's services will not be terminated if Contractor begins within seven days of receipt of notice of intent to terminate to correct its failure to perform and proceeds diligently to cure such failure within no more than 30 days of receipt of said notice.
- E. Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue. Any retention or payment of moneys due Contractor by Owner will not release Contractor from liability.
- F. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 5.01.A, the termination procedures of that bond shall supersede the provisions of Paragraphs 15.02.B and 15.02.C.

15.03 *Owner May Terminate For Convenience*

- A. Upon seven days written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):
 - 1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;
 - 2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses;
 - 3. all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) incurred in settlement of terminated contracts with Subcontractors, Suppliers, and others; and
 - 4. reasonable expenses directly attributable to termination.
- B. Contractor shall not be paid on account of loss of anticipated profits or revenue or other economic loss arising out of or resulting from such termination.

15.04 *Contractor May Stop Work or Terminate*

- A. If, through no act or fault of Contractor, (i) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (ii) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (iii) Owner fails for 30 days

to pay Contractor any sum finally determined to be due, then Contractor may, upon seven days written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the Contract and recover from Owner payment on the same terms as provided in Paragraph 15.03.

- B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, seven days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The provisions of this Paragraph 15.04 are not intended to preclude Contractor from making a Claim under Paragraph 10.05 for an adjustment in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to Contractor's stopping the Work as permitted by this Paragraph.

ARTICLE 16 – DISPUTE RESOLUTION

16.01 Methods and Procedures

- A. Either Owner or Contractor may request mediation of any Claim submitted to Engineer for a decision under Paragraph 10.05 before such decision becomes final and binding. The mediation will be governed by the Construction Industry Mediation Rules of the American Arbitration Association in effect as of the Effective Date of the Agreement. The request for mediation shall be submitted in writing to the American Arbitration Association and the other party to the Contract. Timely submission of the request shall stay the effect of Paragraph 10.05.E.
- B. Owner and Contractor shall participate in the mediation process in good faith. The process shall be concluded within 60 days of filing of the request. The date of termination of the mediation shall be determined by application of the mediation rules referenced above.
- C. If the Claim is not resolved by mediation, Engineer's action under Paragraph 10.05.C or a denial pursuant to Paragraphs 10.05.C.3 or 10.05.D shall become final and binding 30 days after termination of the mediation unless, within that time period, Owner or Contractor:
1. elects in writing to invoke any dispute resolution process provided for in the Supplementary Conditions; or
 2. agrees with the other party to submit the Claim to another dispute resolution process; or
 3. gives written notice to the other party of the intent to submit the Claim to a court of competent jurisdiction.

ARTICLE 17 – MISCELLANEOUS

17.01 Giving Notice

- A. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if:

1. delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended; or
2. delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the giver of the notice.

17.02 *Computation of Times*

- A. When any period of time is referred to in the Contract Documents by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

17.03 *Cumulative Remedies*

- A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or by other provisions of the Contract Documents. The provisions of this Paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right, and remedy to which they apply.

17.04 *Survival of Obligations*

- A. All representations, indemnifications, warranties, and guarantees made in, required by, or given in accordance with the Contract Documents, as well as all continuing obligations indicated in the Contract Documents, will survive final payment, completion, and acceptance of the Work or termination or completion of the Contract or termination of the services of Contractor.

17.05 *Controlling Law*

- A. This Contract is to be governed by the law of the state in which the Project is located.

17.06 *Headings*

- A. Article and paragraph headings are inserted for convenience only and do not constitute parts of these General Conditions.

Supplementary Conditions

These Supplementary Conditions amend or supplement the Standard General Conditions of the Construction Contract (No. C-700, 2007 Edition) and other provisions of the Contract Documents as indicated below. All provisions that are not so amended or supplemented remain in full force and effect.

The terms used in these Supplementary Conditions will have the meanings indicated in the General Conditions. Additional terms used in these Supplementary Conditions have the meanings stated below, which are applicable to both the singular and plural thereof.

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SC-1.01.A.2. Add the following new Paragraph after Paragraph 1.01.A.1:

The Project is financed in whole or in part by USDA Rural Utilities Service pursuant to the Consolidated Farm and Rural Development Act (7 USC Section 1921 et seq.). The Rural Utilities Service programs are administered through the USDA Rural Development offices; therefore, the Agency for these documents is USDA Rural Development

SC-1.01.A.9. Add the following language to the end of Paragraph 1.01.A.9:

Agency approval is required before Change Orders are effective.

SC-4.02. Add the following new paragraphs immediately after Paragraph 4.02.B:

- C. In the preparation of Drawings and Specifications, Engineer may have relied upon reports of exploration and tests of subsurface conditions and/or drawings of physical conditions in or relating to existing surface and subsurface structures (except Underground Facilities) which are at or contiguous to the Site:

1. Refer to Table of Contents and/or "technical data" included in these documents. .

SC-4.06. Add the following new paragraphs immediately after Paragraph 4.06.A:

1. In the preparation of Drawings and Specifications, Engineer may have relied upon reports of Hazardous Environmental Conditions at the Site:
 - a. Refer to Table of Contents and/or “technical data” included in these documents.

SC-5.04. Add the following new paragraph immediately after Paragraph 5.04.B:

- C. The limits of liability for insurance required by Paragraph 5.04 of the General Conditions shall provide coverage for not less than the following amounts or greater where required by Laws and Regulations:
 1. Workers’ Compensation, and related coverages under Paragraphs 5.04.A.1 and A.2 of the General Conditions:
 - a. State: Statutory
 - b. Applicable Federal
(e.g., Longshoremen’s) Statutory
 - c. Employer’s Liability \$ 500,000
 2. Contractor’s General Liability under Paragraphs 5.04.A.3 through A.6 of the General Conditions which shall include completed operations and product liability coverages and eliminate the exclusion with respect to property under the care, custody, and control of the Contractor:
 - a. General Aggregate \$ 2,000,000
 - b. Products - Completed
Operations Aggregate \$ 1,000,000
 - c. Personal and Advertising
Injury \$ 1,000,000
 - d. Each Occurrence
(Bodily Injury and
Property Damage) \$ 2,000,000
 - e. Property Damage liability
insurance will provide
Explosion, Collapse, and
Underground coverages where
applicable.
 - f. Excess or Umbrella Liability
 - 1) General Aggregate \$ 5,000,000
 - 2) Each Occurrence \$ 5,000,000

3. Automobile Liability under Paragraph 5.04.A.6 of the General Conditions:

- a. Bodily Injury:
 - Each Person \$ 1,000,000
 - Each Accident \$ 1,000,000
- b. Property Damage:
 - Each Accident \$ 1,000,000
- c. Combined Single Limit of \$ 1,000,000

4. The Contractual Liability coverage required by paragraph 5.04.B.4 of the General Conditions shall provide coverage for not less than the following amounts:

- a. Bodily Injury:
 - Each Person \$ 2,000,000
 - Each Accident \$ 2,000,000
- b. Property Damage:
 - Each Accident \$ 2,000,000
 - Annual Aggregate \$ 2,000,000

SC-6.05.C. Amend the paragraph by making two subparagraphs under the title C. Engineer's Evaluation. The paragraph text is retitled, 6.05.C.2 After Effective Date of Agreement. A new paragraph is added before this paragraph to read as follows:

1. During Bidding. The Contract for the Work, if awarded, will be on the basis of materials and equipment specified or described in the Bidding Documents, and those "or-equal" or substitute materials and equipment subsequently approved by Engineer prior to the submittal of Bids and identified by Addendum. No item of material or equipment will be considered by Engineer as an "or-equal" or substitute unless written request for approval has been submitted by Bidder and has been received by Engineer at least 15 days prior to the date for receipt of Bids in the case of a proposed substitute and 5 days prior in the case of a proposed "or-equal." Each such request shall comply with the requirements of Paragraph 6.05 of the General Conditions and the specifications. Each such request shall include Manufacturer's Certification letter for compliance with Section 746 of Title VII of the Consolidated Appropriations Act of 2017 (Division A - Agriculture, Rural Development, Food and Drug Administration, and Related Agencies Appropriations Act, 2017) and subsequent statutes mandating domestic preference, if applicable. Refer to Manufacturer's Certification Letter provided in these Contract Documents. The burden of proof of the merit of the proposed item is upon Bidder. Engineer's decision of approval or disapproval of a proposed item will be final. If Engineer approves any such proposed item, such approval will be set forth in an Addendum issued to all prospective Bidders. Bidders shall not rely upon approvals made in any other manner. Substitutes and "or-equal" materials and equipment may be proposed by Contractor in accordance with Paragraph 6.05 of the General Conditions after the Effective Date of the Contract.

SC-6.06 Add a new paragraph immediately after Paragraph 6.06.G:

The Contractor shall not award Work valued at more than fifty (50%) percent of the Contract Price to Subcontractor(s), without prior written approval of the Owner.

SC-14.02.A.3. Add the following language at the end of paragraph 14.02.A.3:

No payments will be made that would deplete the retainage, place in escrow any funds that are required for retainage, or invest the retainage for the benefit of the Contractor.

SC-14.02.A.4. Add the following new Paragraph after Paragraph 14.02.A.3:

The Agency must approve all Applications for Payment before payment is made.

SC-14.02.C.1. Delete Paragraph 14.02.C.1 in its entirety and insert the following in its place:

1. The Application for Payment with Engineer's recommendations will be presented to the Owner and Agency for consideration. If both the Owner and Agency find the Application for Payment acceptable, the recommended amount less any reduction under the provisions of Paragraph 14.02.D will become due 30 days after the Application for Payment is presented to the Owner, and the Owner will make payment to the Contractor.

SC-18 Add a new Article 18, "Federal Requirements," after Article 17.

SC-18.01 Add the following language at the beginning of Article 18 with the title "Agency Not a Party."

- A. This Contract is expected to be funded in part with funds provided by Agency. Neither Agency, nor any of its departments, entities, or employees is a party to this Contract.

SC-18.02 Add the following language after Article 18.01.A with the title "Contract Approval."

- A. Owner and Contractor will furnish Owner's attorney such evidence as required so that Owner's attorney can complete and execute the following "Certificate of Owner's Attorney" (Exhibit GC-A) before Owner submits the executed Contract Documents to Agency for approval.
- B. Concurrence by Agency in the award of the Contract is required before the Contract is effective.

SC 18.03 Add the following language after Article 18.02.B with the title “Conflict of Interest.”

- A. Contractor may not knowingly contract with a supplier or manufacturer if the individual or entity who prepared the plans and specifications has a corporate or financial affiliation with the supplier or manufacturer. Owner’s officers, employees, or agents shall not engage in the award or administration of this Contract if a conflict of interest, real or apparent, would be involved. Such a conflict would arise when: (i) the employee, officer or agent; (ii) any member of their immediate family; (iii) their partner or (iv) an organization that employs, or is about to employ, any of the above, has a financial interest in Contractor. Owner’s officers, employees, or agents shall neither solicit nor accept gratuities, favors or anything of monetary value from Contractor or subcontractors.

SC-18.04 Add the following language after Article 18.03.A with the title “Gratuities.”

- A. If Owner finds after a notice and hearing that Contractor, or any of Contractor’s agents or representatives, offered or gave gratuities (in the form of entertainment, gifts, or otherwise) to any official, employee, or agent of Owner or Agency in an attempt to secure this Contract or favorable treatment in awarding, amending, or making any determinations related to the performance of this Contract, Owner may, by written notice to Contractor, terminate this Contract. Owner may also pursue other rights and remedies that the law or this Contract provides. However, the existence of the facts on which Owner bases such findings shall be an issue and may be reviewed in proceedings under the dispute resolution provisions of this Contract.
- B. In the event this Contract is terminated as provided in paragraph 18.04.A, Owner may pursue the same remedies against Contractor as it could pursue in the event of a breach of this Contract by Contractor. As a penalty, in addition to any other damages to which it may be entitled by law, Owner may pursue exemplary damages in an amount (as determined by Owner) which shall not be less than three nor more than ten times the costs Contractor incurs in providing any such gratuities to any such officer or employee.

SC-18.05 Add the following language after Article 18.04.B with the title “Audit and Access to Records.”

- A. Owner, Agency, the Comptroller General of the United States, or any of their duly authorized representatives, shall have access to any books, documents, papers, and records of the Engineer which are pertinent to the Agreement, for the purpose of making audits, examinations, excerpts, and transcriptions. Engineer shall maintain all required records for three years after final payment is made and all other pending matters are closed.

SC-18.06 Add the following language after Article 18.05.A with the title “Small, Minority and Women’s Businesses.”

- A. If Contractor intends to let any subcontracts for a portion of the work, Contractor shall take affirmative steps to assure that small, minority and women’s businesses are used

when possible as sources of supplies, equipment, construction, and services. Affirmative steps shall consist of: (1) including qualified small, minority and women's businesses on solicitation lists; (2) assuring that small, minority and women's businesses are solicited whenever they are potential sources; (3) dividing total requirements when economically feasible, into small tasks or quantities to permit maximum participation of small, minority, and women's businesses; (4) establishing delivery schedules, where the requirements of the work permit, which will encourage participation by small, minority and women's businesses; (5) using the services and assistance of the Small Business Administration and the Minority Business Development Agency of the U.S. Department of Commerce; (6) requiring each party to a subcontract to take the affirmative steps of this section; and (7) Contractor is encouraged to procure goods and services from labor surplus area firms.

SC-18.07 Add the following after Article 18.06.A with the title "Anti-Kickback."

- A. Contractor shall comply with the Copeland Anti-Kickback Act (18 USC 874 and 40 USC 276c) as supplemented by Department of Labor regulations (29 CFR Part 3, "Contractors and Subcontractors on Public Buildings or Public Works Financed in Whole or in Part by Loans or Grants of the United States"). The Act provides that Contractor or subcontractor shall be prohibited from inducing, by any means, any person employed in the construction, completion, or repair of public facilities, to give up any part of the compensation to which they are otherwise entitled. Owner shall report all suspected or reported violations to Agency.

SC-18.08 Add the following after Article 18.07.A with the title "Clean Air and Pollution Control Acts."

- A. If this Contract exceeds \$100,000, Compliance with all applicable standards, orders, or requirements issued under section 306 of the Clean Air Act (42 U.S.C. 1857(h) and 42 USC 7401et. seq.), section 508 of the Clean Water Act (33 U.S.C. 1368) and Federal Water Pollution Control Act (33 USC 1251 et seq.), Executive Order 11738, and Environmental Protection Agency regulations (40 CFR part 15) is required. Contractor will report violations to the Agency and the Regional Office of the EPA.

SC-18.09 Add the following after Article 18.08 with the title "State Energy Policy."

- A. Contractor shall comply with the Energy Policy and Conservation Act (P.L. 94-163). Mandatory standards and policies relating to energy efficiency, contained in any applicable State Energy Conservation Plan, shall be utilized.

SC-18.10 Add the following after Article 18.09 with the title “Equal Opportunity Requirements.”

- A. If this Contract exceeds \$10,000, Contractor shall comply with Executive Order 11246, “Equal Employment Opportunity,” as amended by Executive Order 11375, “Amending Executive Order 11246 Relating to Equal Employment Opportunity,” and as supplemented by regulations at 41 CFR part 60, “Office of Federal Contract Compliance Programs, Equal Employment Opportunity, Department of Labor.”
- B. Contractor’s compliance with Executive Order 11246 shall be based on its implementation of the Equal Opportunity Clause, specific affirmative action obligations required by the Standard Federal Equal Employment Opportunity Construction Contract Specifications, as set forth in 41 CFR Part 60-4 and its efforts to meet the goals established for the geographical area where the Contract is to be performed. The hours of minority and female employment and training must be substantially uniform throughout the length of the Contract, and in each trade, and Contractor shall make a good faith effort to employ minorities and women evenly on each of its projects. The transfer of minority or female employees or trainees from Contractor to Contractor or from project to project for the sole purpose of meeting Contractor’s goals shall be a violation of the Contract, the Executive Order, and the regulations in 41 CFR Part 60-4. Compliance with the goals will be measured against the total work hours performed.
- C. Contractor shall provide written notification to the Director of the Office of Federal Contract Compliance Programs within 10 working days of award of any construction subcontract in excess of \$10,000 at any tier for construction work under the Contract resulting from this solicitation. The notification shall list the name, address, and telephone number of the subcontractor; employer identification number; estimated dollar amount of subcontract; estimated starting and completion dates of the subcontract; and the geographical area in which the Contract is to be performed.

SC-18.11 Add the following after Article 18.10.C with the title “Restrictions on Lobbying.”

- A. Contractor and each subcontractor shall comply with Restrictions on Lobbying (Public Law 101-121, Section 319) as supplemented by applicable Agency regulations. This Law applies to the recipients of contracts and subcontracts that exceed \$100,000 at any tier under a Federal loan that exceeds \$150,000 or a Federal grant that exceeds \$100,000. If applicable, Contractor must complete a certification form on lobbying activities related to a specific Federal loan or grant that is a funding source for this Contract. Each tier certifies to the tier above that it will not and has not used Federal appropriated funds to pay any person or organization for influencing or attempting to influence an officer or employee of any agency, a member of Congress, or an employee of a member of Congress in connection with obtaining any Federal contract, grant, or any other award covered by 31 USC 1352. Each tier shall disclose any lobbying with non-Federal funds that takes place in connection with obtaining any Federal award. Certifications and disclosures are forwarded from tier to

tier up to the Owner. Necessary certification and disclosure forms shall be provided by Owner.

SC-18.12 Add the following after Article 18.11.A with the title “Environmental Requirements.”

When constructing a project involving trenching and/or other related earth excavations, Contractor shall comply with the following environmental constraints:

- A. Wetlands – When disposing of excess, spoil, or other construction materials on public or private property, Contractor shall not fill in or otherwise convert wetlands.
- B. Floodplains – When disposing of excess, spoil, or other construction materials on public or private property, Contractor shall not fill in or otherwise convert 100 year floodplain areas delineated on the latest Federal Emergency Management Agency Floodplain Maps, or other appropriate maps, i.e., alluvial soils on NRCS Soil Survey Maps.
- C. Unanticipated Discovery Plan – Historic Preservation: Any excavation or other earth moving activity by the contractor that uncovers cultural resources including historical or archaeological artifacts, human or cultural items, or fossil or other paleontological materials, shall be immediately reported as follows:
 - i. If earth disturbing activities during project construction uncover cultural materials (i.e. structural remains, historic artifacts, or prehistoric artifacts), all work shall cease at the affected location and the Washington State Archaeologist at the Department of Archaeology and Historic Preservation (DAHP), the cultural resource program of the Confederated Tribes of the Colville Nation (CTCN), and RD State Environmental Coordinator (SEC-Paul Johnson (360) 704-7761) shall be notified immediately.
 - ii. If earth disturbing activities during any area of the project uncover human remains, all work shall cease at the affected location immediately in accordance with the Native American Graves Protection and Repatriation Act of 1990 (NAGPRA) and Washington State Statute RCW 27.44. The area around the discovery shall be secured and the Chelan County Coroner and the State Archeologist at DAHP shall be notified immediately. The State Archeologist shall notify RD SEC-Paul Johnson (360) 704-7761 and the CTCN.
 - iii. Construction shall be halted or shifted to a new location pending the notification process and further instructions issued by the agency after consultation with the State Historic Preservation Officer, applicable Indian Tribes, and other appropriate authorities.
- D. Endangered Species – Contractor shall comply with the Endangered Species Act, which provides for the protection of endangered and/or threatened species and critical habitat.

Should any evidence of the presence of endangered and/or threatened species or their critical habitat be brought to the attention of Contractor, Contractor will immediately report this evidence to Owner and a representative of Agency. Construction shall be temporarily halted pending the notification process and further directions issued by Agency after consultation with the U.S. Fish and Wildlife Service.

- E. Mitigation Measures – If the project had an Environmental Report, Environmental Assessment, or Environmental Impact Statement to meet the requirements of the National Environmental Policy Act, compliance with the mitigation measures, if any, in that document are hereby included as a condition of this contract.
- F. Environmental Requirements and Mitigation Measures: The following requirements must be adhered to during project construction:
- i. Equipment must meet current State of Washington regulations for noise. Noise producing equipment will be located in enclosures with acoustic panels designed to reduce noise.
 - ii. Construction activities will be scheduled to reduce traffic, dust and noise impacts in residential areas.
 - iii. The applicant shall obtain any necessary permits from local and other governmental agencies.
 - iv. Applicant to use Construction Best Management Practices (BMP) for temporary erosion and sedimentation controls during construction of project.
 - v. Work in public right-of-ways shall have all necessary permits.
 - vi. The applicant will address any permit conditions needed during construction of the project (including the outfall), such as a Corps of Engineers Permit, Hydraulic Permit Approval, etc.
 - vii. The applicant will be required to apply for Ecology's NOC permit under the Air Quality Program if applicable. A Hydraulic Permit will be required as noted by Washington Fish and Wildlife Service.
 - viii. The applicant shall comply with the recommendations outlined in the Cultural Resource Survey. The applicant shall conduct an on-site investigation to discern sediment types and level of disturbance for further recommendation of possible monitoring for the sewer line collection area. This could be done during initial pot-holing for the project or during geo-technical investigations. If the alternate routes through backyard areas are chosen, there should be additional investigation of those areas.

- ix. The applicant will be required to apply for Ecology's NOC permit under the Air Quality Program if applicable. A Hydraulic Permit will be required as noted by Washington Fish and Wildlife Service.
- x. The applicant may be required to have a NOC (Notice of Construction) permit. The wastewater treatment plant is subject to Ecology's registration program.
- xi. Client to obtain necessary permits from local and other governmental agencies. This includes the Joint Aquatic Resource Permit Application (JARPA), Corps of Engineers and Notice of Construction permits, etc.

Certificate of Owner's Attorney

I, the undersigned, _____, the duly authorized and acting legal representative _____, do hereby certify as follows:

I have examined the attached Contract(s) and performance and payment bond(s) and the manner of execution thereof, and I am of the opinion that each of the aforesaid agreements is adequate and has been duly executed by the proper parties thereto acting through their duly authorized representatives; that said representatives have full power and authority to execute said agreements on behalf of the respective parties named thereon; and that the foregoing agreements constitute valid and legally binding obligations upon the parties executing the same in accordance with the terms, conditions, and provisions thereof.

Date: _____

AGENCY CONCURRENCE

As lender or insurer of funds to defray the costs of this Contract, and without liability for any payments thereunder, the Agency hereby concurs in the form, content, and execution of this Agreement.

By: _____ Date _____

Type Name: _____

These Supplemental Conditions amend or supplement the Standard General Conditions of the Construction Contract (EJCDC C-700), RUS Bulletin 1780-26 Attachment H, and other provisions of the Contract Documents as indicated below. All provisions that are not so amended or supplemented remain in full force and effect.

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SC-1.01.A Defined Terms, the following shall be added list of defined terms.

Correction Period – A guarantee to the Owner by the Contractor that the Work, materials, equipment, and workmanship, is free from known defects and that the Contractor will promptly, without charge, repair or replace defective parts. The words “Correction Period”, warrantee, and guarantee shall be understood to have the same meaning.

Critical Path - The sequence of activities that must be completed on schedule for the entire project to be completed on schedule. This is the longest duration path through the Work.

SC-2.02.A The paragraph shall be replaced with the following:

The Contractor will be provided with five (5) copies of the complete Contract Documents including Drawings. The Contractor may buy additional copies of the Contract Documents from the Engineer at the cost of printing or reproduction.

SC-2.05.B Add the following new Paragraphs 2.05.B, and C after Paragraph 2.05.A

B. Prior to starting construction, the Contractor shall submit to the Washington State Department of Labor and Industries:

- (1) Wage determination and/or additional classifications and wage rate requests.
- (2) Intent to Pay Prevailing Wage (Form F700-029-000).

The Contractor shall provide all subcontractors with Intent to Pay Prevailing Wage, and Affidavit of Wages Paid forms, with the top information section completed with the necessary dates, addresses, etc. to insure proper processing. Subcontractor forms and fees shall be submitted together with the Contractor’s. Copies of all above forms shall be submitted to the Owner.

C. Federal wage rates, if applicable, shall be the hourly minimum wage rate for laborers and mechanics and shall not be less than those contained in the wage determination decision of the Secretary of Labor, United States Department of Labor. If any classes of laborers or mechanics not listed in the wage classification are to be employed, the Contractor shall request the Owner to provide a Report of Additional Classification and Rate from the U.S. Department of Labor.

SC-2.07.A. The second sentence of paragraph 1 shall be revised to read.

Acceptance of the Construction Schedule does not constitute as an approval or acceptance of Contractor's means, methods or sequencing.

SC-3.01 Paragraph A shall be revised to read:

The Contract Documents are complementary. What is required by one part of the Contract Document shall be binding as if required by all. Anything mentioned in the Specifications and not shown on the Drawings, or shown on the Drawing and not mentioned in the Specifications, shall be of like effect as if shown or mentioned in both.

SC-3.03.C Add the following new Paragraphs after Paragraph 3.03.B.

- C. Routing of all elements of mechanical and electrical systems included in the plans is schematic only; CONTRACTOR shall coordinate and make all offsets and rerouting required for a proper installation. The CONTRACT PRICE includes all labor and materials for such coordination, offsets and rerouting.
- D. Any inconsistency in the parts of the Contract shall be resolved by following this order of precedence (e.g. 1 presiding over 2, 3, 4. . .2 presiding over 3, 4, . . . ; and so forth.
 - 1. Addenda
 - 2. Special Requirements/Bid Items, Section 01 01 00
 - 3. Drawings
 - 4. Specifications, except section 01 01 00 noted above
 - 5. General Details
- E. Clarification and interpretation of the Contract Documents shall be issued by Engineer as provided in Article 9.

SC-4.02.A Revise header for Paragraph 4.02.A as follows:

- A. *Reports and Drawing:* The Supplementary Condition and/or Specification Section 01 01 00 identify:

SC-4.02.B Revise Paragraph 4.02.B as follows

Replace "Supplementary Conditions" with "Supplementary Conditions and/or Specification Section 01 01 00"

SC-4.03.C.3 Revise subparagraph 4.03.C.3 as follows:

Replace "subcontractors" with "subconsultants".

SC-5.03.A Add the following sentence to the end of Paragraph 5.03.A.

The certificate of insurance shall name as the insured the Contractor, the Engineer, and the Owner.

SC-5.03.B Paragraph 5.03.B shall be revised as follows:

In the first sentence after “Supplementary Conditions” add “, and/or Specification Section 01 01 00.

SC-5.03.F Add the following Paragraph immediately after Paragraph 5.03.E

F. Cancellation or lapse of the required insurance prior to Contract completion shall be a material breach of the Contract and cause for Contract termination.

SC-5.04.A Paragraph 5.04.A shall be supplemented with the following:

7. excess or umbrella liability insurance in amounts identified in 5.04.C.

SC-5.06.A The first Paragraph of 5.06.A shall be replaced with the following:

A. Contractor shall purchase and maintain property insurance upon the Work at the Site in the amount of the full replacement cost thereof (subject to such deductible amounts as may be required by laws and regulations). This insurance shall:

SC-6.01.B Add the following new sentence to end of Paragraph 6.01.B

If, at any time supervision of the Work is not acceptable to the Engineer or Owner, Contractor shall assign a replacement superintendent.

SC-6.04.A Paragraph 6.04.A shall be revised to read:

A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.07 of the General Conditions and Division 1 of the Specifications adjusted, at a minimum, on a monthly basis or more frequently as otherwise requested by the Engineer.

1. Contractor shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.07 and Division 1 of the Specifications) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times. Such adjustments will comply with any provisions of the General Requirements, Supplemental Conditions and/or Division 1 of the Specifications applicable thereto.
2. Proposed adjustment in the progress Schedule that will change the Contract Times shall be submitted in accordance with the requirements of Article 12. Adjustments in Contract Times may only be made by a Change Order.

SC-6.08.A Revise Paragraph 6.08.A as follows:

In the first sentences following “Supplementary Conditions” add “ and/or Specification Section 01 01 00”.

SC-6.17.A The following shall be added to the end Paragraph 6.17.A.

“The Engineer will review the original submittal and one (1) resubmittal on each item. Subsequent submittal review will be at the Contractor’s cost. Reimbursement will be at the rate of 3.0 times the direct cost to the Engineer and its consultants for all the time spent by them in re-evaluation of the proposed resubmittal.

SC-6.17.C.4 Add the following new Paragraph after Paragraph 6.17.C.3

4. When required pursuant the Contract Documents, SHOP DRAWINGS shall be stamped by an appropriate professional engineer licensed by the State of Washington.

SC-6.20.A Modify as follows:

Paragraph A in the first sentence after the words “Owner and Engineer” add “and State of Washington”.

SC-9.08.D Paragraph D shall be replaced with the following:

When functioning as interpreter and judge under this Paragraph 9.08 or elsewhere in the Contract Documents, Engineer will not show partiality to Owner or Contractor and will not be liable in connection with any interpretation or decision rendered in good faith in such capacity.

SC-9.09.F Add the following new Paragraphs 9.09.F, and 9.09.G.

- F. The presence of the Engineer or Resident Project Representative during any part of the Work shall not relieve the Contractor of his responsibility and obligation to construct the Work according to the Contract Documents. No approval, tacit or otherwise, shall be assumed by the Contractor.
- G. The Engineer will not be responsible for the acts or omissions of the Contractor or of any subcontractors, or of the agents or employees of the Contractor or any subcontractor, or of any other persons at the site or otherwise performing any of the Work.

SC-10.05.B Modify Paragraph 10.05.B as follows and add the following new Paragraph to the end 10.05.B

Change “(but in no event later than 30 days)” to “(but in no event later than 15 days)” AND “. . . to the Contract within 60 days” to “. . . to the Contract within 45 days”.

Supporting data shall be in sufficient detail to enable the Engineer to ascertain the basis and amount of the time requested for each specific Claim. The Contractor shall submit and show on the progress schedule that the; (1) had a specific impact on the critical path, and (2) could not have been avoided by re-sequencing of the Work or other reasonable alternatives.

SC-10.05.G Add the following new Paragraphs 10.05.G, & 10.05.H after Paragraph 10.05.F

- G. Action by the Engineer pursuant to Paragraph 10.05.B with respect to any Claim, (except any which have been waived by the making or acceptance of final payment as provided in Article 14) will be a condition precedent to any exercise by the Contractor of such rights or remedies as it may otherwise have under the Contract Documents or at law in respect of any Claim.
- H. The rendering of a decision by the Engineer pursuant to Paragraph 10.05.C with respect to any such Claim will be a condition precedent to any exercise by the Contractor of such rights or remedies as it may otherwise have under the Contract Documents or at law in respect of any Claim.

SC-11.02 Delete section 11.02 Allowances in its entirety:

SC-13.02.A Delete Paragraph and add the following new Paragraphs A and B:

- A. The Owner, Engineer, their consultants and other representatives and personnel of Owner, and governmental agencies with jurisdictional interests will have access to the Work. In addition, authorized representatives and agents of any participating Federal or State agency shall be permitted to inspect all materials, payrolls, records or personnel, invoices of materials, and other relevant data and records. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's safety procedures and programs so that they may comply therewith as applicable.
- B. The Owner and authorized representatives of state and federal agencies shall have access to any books, documents, papers and records of the Contractor which are directly pertinent to the Contract for the purposes of making audit, examination, excerpts and transcriptions for a period of three years after the final audit.

SC-13.07.F Add the following new Paragraph after 13.07.E

During the Correction Period inspection of the Work eleven (11) months after the date of Substantial Completion, the Contractor shall cooperate with Engineer by having a suitable knowledgeable representative of the Contractor attend such inspection activity.

SC-14.02.A.3 Replace with the new Paragraph 14.02.A.3

3. The Owner shall retain five (5) percent of the amount of each payment until after final completion and acceptance of all Work covered by the Contract.

No payments will be made that would deplete the retainage, place in escrow any funds that are required for retainage, or invest the retainage for the benefit of the Contractor

- a. The monies reserved under the provisions of Article 14 for the protection and payment of any person or persons, mechanic, subcontractor or material men who furnish any labor or materials for the Contractor or works thereunder, and all persons who shall supply any such person or persons or subcontractors with provisions and supplies for the carrying on of such work, and the state with respect to taxes which may be due from such Contractor shall be retained in a fund by the Owner until thirty (30) days following the final acceptance of said improvement of work as completed.
- b. After the expiration of the 30-day period, and after receipt of the State of Washington Department of Revenue's certificate and other certificates if applicable, and the Owner is satisfied that the taxes certified as due or to become due by the Department of Revenue are discharged, and the Claims of material men and laborers who have filed their Claims, together with a sum sufficient to defray the cost of foreclosing and liens of such Claims, and to pay attorneys' fees, have been paid, the Owner shall pay to the Contractor the fund retained by it.
- c. If such taxes have not been discharged, or the Claims, expenses and fees have not been paid, the Owner shall deduct such taxes and such Claims, expenses and fees from the fund retained by it and pay the remainder, if any, to the Contractor.

SC-14.02.B.5 Add the following subparagraphs after subparagraph 14.02.B.5.d

- e. Failure of the Contractor to make payments properly to subcontractors or for material or labor.
- f. Engineer has reasonable doubt that the work can be completed for the balance then unpaid.
- g. Contractor has caused damages to another contractor's Work or to private or public property.
- h. Work on unit price items is substantially complete but lacks clean-up and/or corrections ordered by the Engineer.

SC-14.02.C.1 Modify Paragraph 14.02.C.1 to read as follows:

1. The Application for Payment with Engineer's recommendations will be presented to the Owner and Agency for consideration. If both the Owner and Agency find the Application for Payment acceptable, the recommended amount less any reduction under the provisions of Paragraph 14.02.D will become due 30 days after the Application for Payment is presented to the Owner, and the Owner will make payment to the Contractor.

SC-14.04 Paragraphs 14.04.A and 14.04.B shall be modified as follows:

- A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete, that the applicable official has granted permission or certification of occupancy, and requires the Engineer issue a certificate of Substantial Completion.
- B. Promptly after Contractor's notification, Owner, Engineering and Contractor shall make an inspection of the Work to determine the status of completion. A list of such work that requires correction prior to issuing the Substantial Completion will be compiled and written by the Contractor during the inspection. Once this list ("Deficiency List") has been corrected, the Contractor may request that Engineer issue a certificate of Substantial Completion. Note that the Deficiency List is not the Punch List.

SC-14.04.F Add new Paragraphs 14.04.F and 14.04.G immediately following Paragraph 14.04.E.

- F. Attached to the executed certification of Substantial Completion, the Engineer will provide the Punch List indicating the items of work that must be completed prior to final acceptance.
- G. Note: Final Payment and release of retainage will not be granted until all Punch List items are completed. Each Punch List item, when completed by the Contractor, must be initialed by the Contractor's resident superintendent prior to requesting concurrence by the Engineer.

SC-14.06 Replace Paragraph 14.06.A with the following new Paragraphs:

- A. Upon written notice from the Contractor of completion of the work under the Contract, the Engineer shall make an inspection. The Engineer shall provide inspection and engineering services for only one (1) final inspection. The cost of additional final inspections caused by the Contractor's unacceptable completion of the work may be deducted from the monies due, or being withheld from the Contractor or his surety by the Owner. Engineering costs for additional final inspections will be computed on the basis of the Engineering Services Agreement between the Owner and the Engineer. If, on the first inspection, the Engineer finds the project to be satisfactorily completed in accordance with the Drawings and Specifications, the inspection will constitute the final inspection by the Engineer. If, however, any work is found unacceptable, the Contractor shall immediately correct any

deficiencies. Upon completion of such work, the Contractor shall again give written notice to the Engineer for another inspection.”

- B. Following final inspection by the Engineer, inspection and acceptance by any regulatory and/or funding agencies shall constitute final acceptance of the Project.”

Upon completion of the Project, the Contractor shall submit to the Washington State Department of Labor and Industries, and affidavit of wages paid.

SC-14.07.A.2 Replace Subparagraph “d” with the following:

- d. a notarized affidavit releasing the Owner from any and all liens arising out of this Contract, including lien releases from any and all subcontractors and suppliers who have worked or supplied materials in the construction of the Project.

SC-14.07.A.2 Add the following new subparagraphs after subparagraph “d”:

- e. Copy of Contractor’s and subcontractor’s lists(s) of any subcontractors hired: Affidavit of Wages Paid Addendum B List of Next Tier Subcontractor (Form 700-007-000). Addendum B is to be attached to the Affidavit of Wages Paid from. Forms are available through the Department of Labor and Industries.
- f. 5 copies of the Warrantee Manual including “Contractor’s Warranty” as required in Division 1 of the Contract Documents.
- g. Contractor and subcontractor proof of Worker’s Compensation premiums paid in the form of an Employer Liability Certification (including its State Industrial Account Number) printed from the Department of Labor and Industries website.

SC-16.01 Paragraph A shall be revised to read:

- A. Either Owner or Contractor may request a non-binding mediation of any Claim submitted to Engineer for a decision under Paragraph 10.05 prior to or after commencement of litigation in an effort to amicably resolve any legal dispute. Timely submission of the request shall stay the effect of Paragraph 10.05.E.

SC-16.01.C Subparagraph 3 shall be revised to read:

3. give written notice to the other party of the intent to submit the Claim to the Superior Court for the State of Washington in and for the County in which the project takes place.

Except as may otherwise be specifically provided in the Contract Documents with respect to a legal action commenced to enforce an indemnification or surety provision, each Party shall pay its own attorney’s fees and cost in any litigation, regardless of the outcome.

American Iron and Steel Requirements Supplemental Conditions

The Contractor shall meet all American Iron and Steel Requirements required by Rural Development (RUS 1780-35). The American Iron and Steel Requirements amend or supplement the Standard General Conditions of the Construction Contract (No. C-700, 2007 Edition) and other provisions of the Contract Documents as indicated. Also included are additional responsibilities of the Contractor, Manufacturer, Supplier, and Distributor with regards to the American Iron and Steel Requirements as required by RUS Bulletin 1780-35. All provisions that are not so amended or supplemented remain in full force and effect. Exhibits C, D, E, F, and G from RUS Bulletin 1780-35 are attached.

The terms used in these Supplementary Conditions will have the meanings indicated in the General Conditions. Additional terms used in these Supplementary Conditions have the meanings stated below, which are applicable to both the singular and plural thereof.

ABBREVIATIONS

AIS – American Iron and Steel
ANTHC – Alaska Native Tribal Health Consortium
AWWA – American Water Works Association
CFR – Code of Federal Regulations
EO – Executive Order
NIST – National Institute of Standards and Technology
NSF – National Sanitation Foundation
OGC – Office of General Counsel
PL – Public Law
PER – Preliminary Engineering Report
RAVG – Rural Alaska Village Grant
RD – Rural Development
RUS – Rural Utilities Service
USC – United States Code
USDA – United States Department of Agriculture
WEP – Water and Environmental Programs
WWD – Water and Waste Disposal

EXHIBITS

Exhibit C - General Contractor's Certification of Compliance
Exhibit D - Example Manufacturer's Certification Letter of Compliance
Exhibit E - Examples of Municipal Castings
Exhibit F - Examples of Construction Materials
Exhibit G - Examples of Non-Construction Materials

CONSTRUCTION CONTRACTOR RESPONSIBILITIES

- a Construction contractors must use and install iron and steel products that are compliant with AIS as part of the permanent work.
- (1) Shop drawing submittal: For all iron and steel product subject to AIS, **provide** manufacturers' certification letters (see Exhibit D) to verify the products comply with AIS.
 - (2) Prior to construction: Create a construction project file dedicated to the safe-keeping of manufacturer's certification letters. File shall include all manufacturer's certification letters (see Exhibit D) for any and all iron and steel products subject to AIS to verify the products comply with AIS.
 - (3) Change Order: For any AIS products proposed in a change proposal, **provide** manufacturers' certification letter (see Exhibit D) to the consulting engineer to verify the products comply with AIS.
 - (4) **Acknowledge** responsibility for compliance with AIS requirements on all change orders and partial payment estimates.
 - (5) **Keep** all manufacturer certification letters (including those from the engineer, general contractor and any manufacturer providing AIS products) on site during construction in the construction project file.
 - (6) Substantial completion of the project: **Provide** the general contractor's certification (see Exhibit C) letter to the engineer that all iron and steel products installed comply with AIS. This certification is to be submitted upon substantial completion of the project to the project engineer.

MANUFACTURER, SUPPLIER, DISTRIBUTOR RESPONSIBILITIES

- (1) If iron and steel products are produced in the United States as defined in this Bulletin, **prepare** (*applicable to manufacturers and fabricators*) or **obtain** (*applicable to suppliers, distributors, vendors, etc.*) manufacturers' certification letters (see Exhibit D) and make available upon request to consulting engineers, general contractors, etc.

SUPPLEMENTAL CONTRACT PROVISIONS

RUS Supplementary General Conditions (C-800)

- (a) (C-800, Article SC 1.01.A)
Defined Terms, the following shall be added to the list of defined terms:
"Manufacturer's Certification letter is documentation provided by the manufacturer, supplier, distributor, vendor, fabricator, etc. to various entities stating that the American Iron and Steel products to be used in the project are produced in the United States in accordance with American Iron and Steel requirements. Refer to Manufacturer's Certification Letter provided in these Contract Documents."

- (b) (C-800, Article SC 1.01.A)
Defined Terms, the following shall be added to the list of defined terms:
“AIS - refers to requirements mandated by Section 746 of Title VII of the Consolidated Appropriations Act of 2017 (Division A - Agriculture, Rural Development, Food and Drug Administration, and Related Agencies Appropriations Act, 2017) and subsequent statutes mandating domestic preference. The term “iron and steel products” means the following products made primarily of iron or steel: lined or unlined pipes and fittings, manhole covers and other municipal castings, hydrants, tanks, flanges, pipe clamps and restraints, valves, structural steel, reinforced precast concrete, and construction materials.”
- (c) (C-800, Article SC 6.03)
Add sentence 6.03.D: “All iron and steel products must meet American Iron and Steel requirements.”
- (d) (C-800, Article SC 6.05.F.1)
Add 6.05.F.1: “Contractor shall include a Manufacturer’s Certification letter for compliance with American Iron and Steel requirements in support data, if applicable. Refer to Manufacturer’s Certification Letter provided in these Contract Documents. In addition, for the Deminimis Waiver, Contractor shall maintain an itemized list of incidental components and ensure that the cost is less than 5% of total materials cost for project; for the Minor Components Waiver, the Contractor shall maintain a list of products to which the minor components waiver applies and the cost of the non-domestically produced component is less than 5% of total materials cost of that product.”
- (e) (C-800, Article SC 6.05.A.2.d.1.d)
Add 6.05.A.2.d.1.d: “d) comply with American Iron and Steel by providing Manufacturer’s Certification letter of American Iron and Steel compliance, if applicable. Refer to Manufacturer’s Certification Letter provided in these Contract Documents.”
- (f) (C-800, Article SC 6.12.A)
Modify 6.12.A by inserting the following after “written interpretations and clarifications,”: “Manufacturers’ Certification letter is documentation provided by the manufacturer, supplier, distributor, vendor, fabricator, etc. to various entities stating that the iron and steel products to be used in the project are produced in the United States in accordance with American Iron and Steel Requirements. Refer to Manufacturer’s Certification Letter provided in these Contract Documents.”
- (g) (C-800, Article SC 6.17.C.1.e)
Add 6.17.C.1.e: “e. obtained Manufacturer’s Certification letter for any item in the submittal subject to American Iron and Steel requirements and include

the Certificate in the submittal. Refer to Manufacturer's Certification Letter provided in these Contract Documents."

- (h) (C-800, Article SC 6.17.D.4)
Add 6.17.D.4: "Engineer's review and approval of Shop Drawing or Sample shall include review of compliance with American Iron and Steel requirements, as applicable."
- (i) (C-800, Article SC 6.19.D)
Add 7.17.E: "Contractor shall certify upon Substantial Completion that all Work and Materials has complied with American Iron and Steel requirements as mandated by Section 746 of Title VII of the Consolidated Appropriations Act of 2017 (Division A - Agriculture, Rural Development, Food and Drug Administration, and Related Agencies Appropriations Act, 2017) and subsequent statutes mandating domestic preference. Contractor shall provide said Certification to Owner. Refer to General Contractor's Certification Letter provided in these Contract Documents."
- (j) (C-800, Article SC 9.11.A)
Add 9.11.A American Iron & Steel: "A. "Services required to determine and certify that to the best of the Engineer's knowledge and belief all iron and steel products referenced in engineering analysis, the Plans, Specifications, Bidding Documents, and associated Bid Addenda requiring design revisions are either produced in the United States or are the subject of an approved waiver and services required to determine to the best of the engineer's knowledge and belief that approved substitutes, equals, and all iron and steel products proposed in the shop drawings, Change Orders and Partial Payment Estimates are either produced in the United States or are the subject of an approved waiver under Section 746 of Title VII of the Consolidated Appropriations Act of 2017 (Division A - Agriculture, Rural Development, Food and Drug Administration, and Related Agencies Appropriations Act, 2017).
- (k) (C-800, Article SC 10.05.B)
Modify 10.05.B by inserting the following sentence after the third sentence:
"Include supporting data
(name of manufacturer, city and state where the product was manufactured, description of product, signature of authorized manufacturer's representative) in the Manufacturer's Certification Letter, as applicable."
- (l) (C-800, Article SC 13.01.B)
Add 13.01.B: "B. Installation of Materials that are non-compliant with American Iron and Steel requirements shall be considered defective work."

- (m) (C-800, Article SC 14.02.A.4)
Add 14.02.A.4: “4. By submitting Materials for payment, Contractor is certifying that the submitted Materials are compliant with American Iron and Steel requirements. Manufacturer’s Certification letter for Materials satisfy this certification. Refer to Manufacturer’s Certification Letter provided in these Contract Documents.”
- (n) (C-800, Article SC 14.02.B.2.d)
Add 14.02.B.2.d: “d. the Materials presented for payment comply with American Iron and Steel.”
- (o) (C-800, Article SC 14.04.A)
Modify 14.04.A by adding the following after the last sentence: “Services required to determine and certify that to the best of the Contractor’s knowledge and belief all substitutes, equals, and all iron and steel products proposed in the shop drawings, Change Orders and Partial Payment Estimates, and those installed for the project are either produced in the United States or are the subject of an approved waiver under Section 746 of Title VII of the Consolidated Appropriations Act of 2017 (Division A - Agriculture, Rural Development, Food and Drug Administration, and Related Agencies Appropriations Act, 2017) and subsequent statutes mandating domestic preference.”
- (p) (C-800: Article 18, SC 18.13):
Add “Section 746 of Title VII of the Consolidated Appropriations Act of 2017 (Division A - Agriculture, Rural Development, Food and Drug Administration, and Related Agencies Appropriations Act, 2017) and subsequent statutes mandating domestic preference applies an American Iron and Steel requirement to this project. All iron and steel products used in this project must be produced in the United States. The term “iron and steel products” means the following products made primarily of iron or steel: lined or unlined pipes and fittings, manhole covers and other municipal castings, hydrants, tanks, flanges, pipe clamps and restraints, valves, structural steel, reinforced precast concrete, and construction materials. The de minimis and minor components waiver *{add project specific waivers as applicable}* apply to this contract.”
- (q) (C-800: Article 18, SC 18.14):
Add SC 18.14 Definitions:
“Assistance recipient” is the entity that receives funding assistance from programs required to comply with Section 746 Division A Title VII of the Consolidated Appropriations Act of 2017 (Agriculture, Rural Development,

Food and Drug Administration, and Related Agencies Appropriations Act, 2017) and subsequent statutes mandating domestic preference. This term includes owner and/or applicant.

“Certifications” means the following:

- *Manufacturers’* certification is documentation provided by the manufacturer or fabricator to various entities stating that the iron and steel products to be used in the project are produced in the United States in accordance with American Iron and Steel (AIS) Requirements. If items are purchased via a supplier, distributor, vendor, etc. vs. from the manufacturer or fabricator directly, then the supplier, distributor, vendor, etc. will be responsible for obtaining and providing these certification letters to the parties purchasing the products.
- *Engineers’* certification is documentation that plans, specifications, and bidding documents comply with AIS.
- *Contractors’* certification is documentation submitted upon substantial completion of the project that all iron and steel products installed were produced in the United States.

“Coating” means a covering that is applied to the surface of an object. If a coating is applied to the external surface of a domestic iron or steel component, and the application takes place outside of the United States, said product would be considered a compliant product under the AIS requirements. Any coating processes that are applied to the external surface of iron and steel components that would otherwise be AIS compliant would not disqualify the product from meeting the AIS requirements regardless of where the coating processes occur, provided that final assembly of the product occurs in the United States. This exemption only applies to coatings on the *external surface* of iron and steel components. It does not apply to coatings or linings on internal surfaces of iron and steel products, such as the lining of lined pipes. All manufacturing processes for lined pipes, including the application of pipe lining, must occur in the United States for the product to be compliant with AIS requirements.

“Construction materials” are those articles, materials, or supplies made primarily of iron and steel, that are permanently incorporated into the project, not including mechanical and/or electrical components, equipment and systems. Some of these products may overlap with what is also considered “structural steel”.

Note: Mechanical and electrical components, equipment and systems are not considered construction materials. See definition of mechanical and electrical equipment.

“Consulting engineer” is an individual or entity with which the owner has contracted to perform engineering/architectural services for water and waste projects funded by the programs subject to AIS requirements).

“De minimis incidental components” are various miscellaneous low-cost components that are essential for, but incidental to, the construction and are incorporated into the physical structure of the project. Examples of incidental components could include small washers, screws, fasteners (such as “off the shelf” nuts and bolts), miscellaneous wire, corner bead, ancillary tube, signage, trash bins, door hardware etc.

Costs for such de minimis incidental components cumulatively may comprise no more than a total of five percent of the total cost of the materials used in and incorporated into a project; the cost of an individual item may not exceed one percent of the total cost of the materials used in and incorporated into a project.

“General contractor” is the individual or entity with which the applicant has contracted (*or is expected to*) to perform construction services (or for water and waste projects funded by the programs subject to AIS requirements). This includes bidders, contractors that have received an award from the applicant and any party having a direct contractual relationship with the owner/applicant. A general contractor is often referred to as the prime contractor.

“Iron and steel products” are defined as the following products made primarily of iron or steel: lined or unlined pipes and fittings, manhole covers and other municipal castings, hydrants, tanks, flanges, pipe clamps and restraints, valves, structural steel, reinforced precast concrete, and construction materials. Only items on the above list made primarily of iron or steel, permanently incorporated into the project must be produced in the United States. For example trench boxes, scaffolding or equipment, which are removed from the project site upon completion of the project, are not required to be made of U.S. Iron or Steel.

“Manufacturers” meaning a supplier, fabricator, distributor, materialman, or vendor is an entity with which the applicant, general contractor or with any subcontractor has contracted to furnish materials or equipment to be incorporated in the project by the applicant, contractor or a subcontractor.

“Manufacturing processes” are processes such as melting, refining, forming, rolling, drawing, finishing, and fabricating. Further, if a domestic iron and steel product is taken out of the United States for any part of the manufacturing process, it becomes foreign source material. However, raw materials such as iron ore, limestone and iron and steel scrap are not covered by the AIS requirement, and the material(s), if any, being applied as a coating are similarly not covered. Non-iron or steel components of an iron and steel product may come from non-US sources. For example, for products such as valves and hydrants, the individual non-iron and steel components do not have to be of domestic origin. Raw materials, such as

iron ore, limestone, scrap iron, and scrap steel, can come from non-U.S. sources.

“Mechanical equipment” is typically that which has motorized parts and/or is powered by a motor. “Electrical equipment” is typically any machine powered by electricity and includes components that are part of the electrical distribution system. AIS does apply to mechanical equipment.

“Minor components” are components *within* an iron and/or steel product otherwise compliant with the American Iron and Steel requirements. This is different from the de minimis definition where de minimis pertains to the entire project and the minor component definition pertains to a single product. This waiver, would allow non-domestically produced miscellaneous minor components comprising up to five percent of the total material cost of an otherwise domestically produced iron and steel product to be used. However, unless a separate waiver for a product has been approved, all other iron and steel components in said product must still meet the AIS requirements. This waiver does not exempt the whole product from the AIS requirements only minor components within said product and the iron or steel components of the product must be produced domestically. Valves and hydrants are also subject to the cost ceiling requirements described here. Examples of minor components could include items such pins and springs in valves/hydrants, bands/straps in couplings, and other low cost items such as small fasteners etc.

“Municipal castings” are cast iron or steel infrastructure products that are melted and cast. They typically provide access, protection, or housing for components incorporated into utility owned drinking water, storm water, wastewater, and solid waste infrastructure.

“National Office” refers to the office responsible for the oversight and administration of the program nationally. The National Office sets policy, develops program regulations, and provides training and technical assistance to help the state offices administer the program. The National Office is located in Washington, D.C.

“Owner” is the individual or entity with which the general contractor has contracted regarding the work, and which has agreed to pay the general contractor for the performance of the work, pursuant to the terms of the contract for water and waste projects funded by the programs subject to AIS requirements. For the purpose of this Bulletin, this term is synonymous with the term “applicant” as defined in 7 CFR 1780.7 (a) (1), (2) and (3) and is an entity receiving financial assistance from the programs subject to the AIS requirements.

“Pass through Entities” is an entity that provides a subaward to a loan and/or grant recipient to carry out part of a Federal program. Examples are grantees utilizing the Revolving Loan Program and Household Water Well Program and Alaska Native Tribal Health Consortium (ANTHC) or the State of Alaska from the RAVG Program.

“Primarily iron or steel” is defined as a product made of greater than 50 percent iron or steel, measured by cost. The cost should be based on the material costs. An exception to this definition is reinforced precast concrete (see Definitions). All technical specifications and applicable industry standards (e.g. NIST, NSF, AWWA) must be met. If a product is determined to be less than 50 percent iron and steel, the AIS requirements do not apply.

For example, the cost of a fire hydrant includes:

- (1) The cost of materials used for the iron portion of a fire hydrant (e.g. bonnet, body and shoe); and
- (2) The cost to pour and cast to create those components (e.g. labor and energy).

Not included in the cost are:

- (1) The additional material costs for the non-iron and steel internal workings of the hydrant (e.g. stem, coupling, valve, seals, etc.); and
- (2) The cost to assemble the internal workings into the hydrant body.

“Produced in the United States” means that the production in the United States of the iron or steel products used in the project requires that all manufacturing processes must take place in the United States, with the exception of metallurgical processes involving refinement of steel additives.

“Project” is the total undertaking to be accomplished for the applicant by consulting engineers, general contractors, and others, including the planning, study, design, construction, testing, commissioning, and start-up, and of which the work to be performed under the contract is a part. A project includes all activity that an applicant is undertaking to be financed in whole or part by programs subject to AIS requirements. The intentional splitting of projects into separate and smaller contracts or obligations to avoid AIS requirements is prohibited.

“Reinforced Precast Concrete” may not consist of at least 50 percent iron or steel, but the reinforcing bar and wire must be produced in the United States and meet the same standards as for any other iron or steel product. Additionally, the casting of the concrete product must take place in the United States. The cement and other raw materials used in concrete production are not required to be of domestic origin. If the reinforced concrete is cast at the construction site, the reinforcing bar and wire are

considered to be a construction material and must be produced in the United States.

“Steel” means an alloy that includes at least 50 percent iron, between 0.02 and 2 percent carbon, and may include other elements. Metallic elements such as chromium, nickel, molybdenum, manganese, and silicon may be added during the melting of steel for the purpose of enhancing properties such as corrosion resistance, hardness, or strength. The definition of steel covers carbon steel, alloy steel, stainless steel, tool steel, and other specialty steels.

“Structural steel” is rolled flanged shapes, having at least one dimension of their cross-section three inches or greater, which are used in the construction of bridges, buildings, ships, railroad rolling stock, and for numerous other constructional purposes. Such shapes are designated as wide-flange shapes, standard I-beams, channels, angles, tees, and zees. Other shapes include but are not limited to, H-piles, sheet piling, tie plates, cross ties, and those for other special purposes.

“Ultimate recipient” is a loan or grant recipient receiving funds from a pass-through entity. Examples include: (1) a loan recipient from the Revolving Loan Fund; (2) a loan recipient from the Household Water Well Program; and (3) a grant recipient from ANTHC or the State of Alaska from the RAVG Program.

“United States” means each of the several states, the District of Columbia, and each Federally Recognized Indian Tribe.

GENERAL (PRIME) CONTRACTOR'S CERTIFICATION OF COMPLIANCE WITH PROVISIONS OF THE AMERICAN IRON AND STEEL REQUIREMENTS OF SECTION 746 OF TITLE VII OF THE CONSOLIDATED APPROPRIATIONS ACT OF 2017 (DIVISION A - AGRICULTURE, RURAL DEVELOPMENT, FOOD AND DRUG ADMINISTRATION, AND RELATED AGENCIES APPROPRIATIONS ACT, 2017) AND SUBSEQUENT STATUTES MANDATING DOMESTIC PREFERENCE

DATE:

RE: PROJECT NAME
APPLICANT
CONTRACT NUMBER

I hereby certify that to the best of my knowledge and belief all iron and steel products installed for this project by my company and by any and all subcontractors and manufacturers my company has contracted with for this project comply with Section 746 of Title VII of the Consolidated Appropriations Act of 2017 (Division A - Agriculture, Rural Development, Food and Drug Administration, and Related Agencies Appropriations Act, 2017) and subsequent statutes mandating domestic preference or are the subject of a waiver approved by the Secretary of Agriculture or designee.

This certification is to be submitted upon completion of the project to the project engineer.

Name of Construction Company (PRINT)

By Authorized Representative (SIGNATURE)

Title

EXAMPLE OF A MANUFACTURER'S CERTIFICATION LETTER OF COMPLIANCE WITH PROVISIONS OF THE AMERICAN IRON AND STEEL (AIS) REQUIREMENTS OF SECTION 746 OF TITLE VII OF THE CONSOLIDATED APPROPRIATIONS ACT OF 2017 (DIVISION A - AGRICULTURE, RURAL DEVELOPMENT, FOOD AND DRUG ADMINISTRATION, AND RELATED AGENCIES APPROPRIATIONS ACT, 2017) AND SUBSEQUENT STATUTES MANDATING DOMESTIC PREFERENCE

Date:

Company Name:

Company Address:

Subject: AIS Step Certification for Project (X), Owner's Name, and Contract Number

I, (company representative), certify that the (melting, bending, galvanizing, cutting, etc.) processes for (manufacturing or fabricating) the following products and/or material shipped or provided for the subject project is in full compliance with the AIS requirement as mandated by Section 746 of Title VII of the Consolidated Appropriations Act of 2017 (Division A - Agriculture, Rural Development, Food and Drug Administration, and Related Agencies Appropriations Act, 2017) and subsequent statutes mandating domestic preference.

Item, Products and/or Materials, and location of delivery (City, State):

- 1.
- 2.

Such processes for AIS took place at the following location:

(City, State)

This certification is to be submitted upon request to interested parties (e.g. municipalities, consulting engineers, general contractors, etc.)

If any of the above compliance statements change while providing materials to this project, please immediately notify the person(s) who is requesting to use your product(s).

Authorized Company Representative Signature

(Note: *Authorized signature shall be manufacturer's representative not the material distributor or supplier*)

EXAMPLES OF MUNICIPAL CASTINGS (*includes but not limited to*):

Access Hatches;
Ballast Screen;
Benches (Iron or Steel);
Bollards;
Cast Bases;
Cast Iron Hinged Hatches, Square and Rectangular;
Cast Iron Riser Rings;
Catch Basin Inlet;
Cleanout/Monument Boxes;
Construction Covers and Frames;
Curb and Corner Guards;
Curb Openings;
Detectable Warning Plates;
Downspout Shoes (Boot, Inlet);
Drainage Grates, Frames and Curb Inlets;
Inlets;
Junction Boxes;
Lampposts;
Manhole Covers, Rings and Frames, Risers;
Meter Boxes;
Service Boxes;
Steel Hinged Hatches, Square and Rectangular;
Steel Riser Rings;
Trash receptacles;
Tree Grates;
Tree Guards;
Trench Grates; and
Valve Boxes, Covers and Risers.

EXAMPLES OF CONSTRUCTION MATERIALS (*includes but not limited to*):

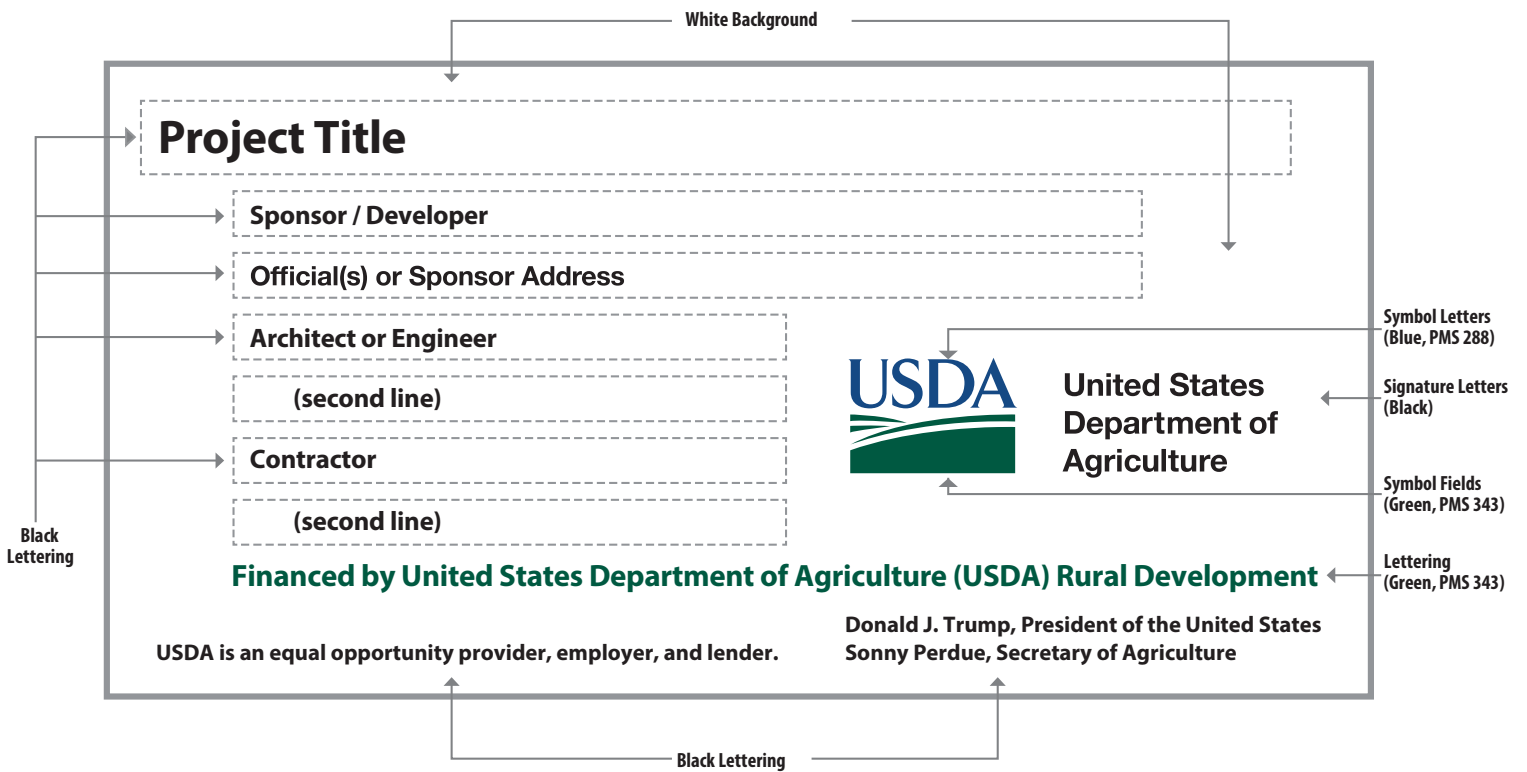
Wire rod, bar, angles
Concrete reinforcing bar, wire, wire cloth
Wire rope and cables
Tubing
Framing
Joists
Trusses
Fasteners (i.e., nuts and bolts)
Welding rods
Decking
Grating
Railings
Stairs
Access ramps
Fire escapes
Ladders
Wall panels
Dome structures
Roofing
Ductwork
Surface drains
Cable hanging systems
Manhole steps
Fencing and fence tubing
Guardrails
Doors
Stationary screens

EXAMPLES OF NON-CONSTRUCTION MATERIALS – *(includes but not limited to):*
(NOTE: *includes appurtenances necessary for their intended use and operation and are not subject to AIS*)

Pumps
Motors
Gear reducers
Drives (including variable frequency drives (VFDs))
Electric/pneumatic/manual accessories used to operate valves (such as electric valve actuators)
Mixers
Gates (e.g. sluice and slide gates)
Motorized screens (such as traveling screens)
Blowers/aeration equipment
Compressors
Meters (flow and water meters)
Sensors
Controls and switches
Supervisory control Data acquisition (SCADA)
Membrane bioreactor systems
Membrane filtration systems (includes RO package plants)
Filters
Clarifier arms and clarifier mechanisms
Rakes
Grinders
Disinfection systems
Presses (including belt presses)
Conveyors
Cranes
HVAC (excluding ductwork)
Water heaters
Heat exchangers
Generators
Cabinetry and housings (such as electrical boxes/enclosures)
Lighting fixtures
Electrical conduit
Emergency life systems
Metal office furniture
Shelving
Laboratory equipment
Analytical instrumentation
Dewatering equipment.

TEMPORARY CONSTRUCTION SIGN FOR RURAL DEVELOPMENT PROJECTS

Recommended Fonts: Helvetica, Arial, or Myriad Pro



SIGN DIMENSIONS : 1200 mm x 2400 mm x 19 mm (approx. 4' x 8' x 3/4")
PLYWOOD PANEL (APA RATED A-B GRADE-EXTERIOR)

WAGE RATES

State Prevailing Wage Rate Determinations (RCW 39.12)

NOTE:

The Contractor is required to pay the applicable State prevailing wage rate. It is the Contractor's sole responsibility to comply with all provisions of State labor standard requirements. If the Contractor utilizes labor classifications for which wage rate determinations are not reproduced in these Contract Documents, such determinations shall nevertheless be considered as enforceable provisions of this Contract, as though fully set forth herein.

There is no guarantee that labor can be obtained at these wages, or that the State minimum wage rates will remain the same for any particular period of time. State minimum wage rates may change from those included herein, before or after the date of bid opening. The Contractor will not be allowed additional compensation for any wage rate increase that is or may become applicable to this project or for any increase in labor costs due State minimum wage or other labor requirements which are, or may become, applicable to this project.

It is the Contractor's sole responsibility to ensure that all subcontractors comply with these requirements.

The State prevailing wage rates and benefits found on the Labor and Industries web site
<http://www.lni.wa.gov/TradesLicensing/PrevWage/default.asp>

County Chelan County

Bid Date January 29, 2020

State of Washington
 Department of Labor & Industries
 Prevailing Wage Section - Telephone 360-902-5335
 PO Box 44540, Olympia, WA 98504-4540

Washington State Prevailing Wage

The PREVAILING WAGES listed here include both the hourly wage rate and the hourly rate of fringe benefits. On public works projects, worker's wage and benefit rates must add to not less than this total. A brief description of overtime calculation requirements are provided on the Benefit Code Key.

Journey Level Prevailing Wage Rates for the Effective Date: 01/29/2020

<u>County</u>	<u>Trade</u>	<u>Job Classification</u>	<u>Wage</u>	<u>Holiday</u>	<u>Overtime</u>	<u>Note</u>	<u>*Risk Class</u>
Chelan	Asbestos Abatement Workers	Journey Level	\$41.09	7A	4V	8Y	View
Chelan	Boilermakers	Journey Level	\$69.04	5N	1C		View
Chelan	Brick Mason	Journey Level	\$50.44	5A	1M		View
Chelan	Building Service Employees	Janitor	\$13.50		1		View
Chelan	Building Service Employees	Shampooer	\$13.50		1		View
Chelan	Building Service Employees	Waxer	\$13.50		1		View
Chelan	Building Service Employees	Window Cleaner	\$13.50		1		View
Chelan	Cabinet Makers (In Shop)	Journey Level	\$22.09		1		View
Chelan	Carpenters	Acoustical Worker	\$47.37	7E	4X	8N	View
Chelan	Carpenters	Bridge, Dock And Wharf Carpenters	\$62.44	7A	4C		View
Chelan	Carpenters	Floor Layer & Floor Finisher	\$47.37	7E	4X	8N	View
Chelan	Carpenters	Form Builder	\$47.37	7E	4X	8N	View
Chelan	Carpenters	General Carpenter	\$47.37	7E	4X	8N	View
Chelan	Carpenters	Heavy Construction Carpenter	\$52.35	7E	4X	9E	View
Chelan	Carpenters	Scaffold/Shoring Erecting & Dismantling	\$52.35	7E	4X	8N	View
Chelan	Cement Masons	Journey Level	\$45.14	7B	1N		View
Chelan	Divers & Tenders	Bell/Vehicle or Submersible Operator (Not Under Pressure)	\$116.20	7A	4C		View
Chelan	Divers & Tenders	Dive Supervisor/Master	\$79.23	7A	4C		View
Chelan	Divers & Tenders	Diver	\$116.20	7A	4C	8V	View
Chelan	Divers & Tenders	Diver On Standby	\$74.23	7A	4C		View
Chelan	Divers & Tenders	Diver Tender	\$67.31	7A	4C		View
Chelan	Divers & Tenders	Manifold Operator	\$67.31	7A	4C		View
Chelan	Divers & Tenders	Manifold Operator Mixed Gas	\$72.31	7A	4C		View
Chelan	Divers & Tenders	Remote Operated Vehicle Operator/Technician	\$67.31	7A	4C		View
Chelan	Divers & Tenders	Remote Operated Vehicle Tender	\$62.69	7A	4C		View
Chelan	Dredge Workers	Assistant Engineer	\$56.44	5D	3F		View

Chelan	Dredge Workers	Assistant Mate (Deckhand)	\$56.00	5D	3F		View
Chelan	Dredge Workers	Boatmen	\$56.44	5D	3F		View
Chelan	Dredge Workers	Engineer Welder	\$57.51	5D	3F		View
Chelan	Dredge Workers	Leverman, Hydraulic	\$58.67	5D	3F		View
Chelan	Dredge Workers	Mates	\$56.44	5D	3F		View
Chelan	Dredge Workers	Oiler	\$56.00	5D	3F		View
Chelan	Drywall Applicator	Journey Level	\$47.37	7E	4X	8N	View
Chelan	Drywall Tapers	Journey Level	\$42.54	7E	1P		View
Chelan	Electrical Fixture Maintenance Workers	Journey Level	\$13.50		1		View
Chelan	Electricians - Inside	Cable Splicer	\$72.98	7H	1E		View
Chelan	Electricians - Inside	Construction Stock Person	\$36.47	7H	1D		View
Chelan	Electricians - Inside	Journey Level	\$68.42	7H	1E		View
Chelan	Electricians - Motor Shop	Craftsman	\$15.37		1		View
Chelan	Electricians - Motor Shop	Journey Level	\$14.69		1		View
Chelan	Electricians - Powerline Construction	Cable Splicer	\$79.60	5A	4D		View
Chelan	Electricians - Powerline Construction	Certified Line Welder	\$72.98	5A	4D		View
Chelan	Electricians - Powerline Construction	Groundperson	\$47.94	5A	4D		View
Chelan	Electricians - Powerline Construction	Heavy Line Equipment Operator	\$72.98	5A	4D		View
Chelan	Electricians - Powerline Construction	Journey Level Lineperson	\$72.98	5A	4D		View
Chelan	Electricians - Powerline Construction	Line Equipment Operator	\$62.06	5A	4D		View
Chelan	Electricians - Powerline Construction	Meter Installer	\$47.94	5A	4D	8W	View
Chelan	Electricians - Powerline Construction	Pole Sprayer	\$72.98	5A	4D		View
Chelan	Electricians - Powerline Construction	Powderperson	\$54.55	5A	4D		View
Chelan	Electronic Technicians	Electronic Technicians Journey Level	\$45.23	5B	1B		View
Chelan	Elevator Constructors	Mechanic	\$94.22	7D	4A		View
Chelan	Elevator Constructors	Mechanic In Charge	\$101.73	7D	4A		View
Chelan	Fabricated Precast Concrete Products	Journey Level	\$13.50		1		View
Chelan	Fabricated Precast Concrete Products	Journey Level - In-Factory Work Only	\$13.50		1		View
Chelan	Fence Erectors	Fence Erector	\$38.59	7A	4V	8Y	View
Chelan	Fence Erectors	Fence Laborer	\$38.59	7A	4V	8Y	View
Chelan	Flaggers	Journey Level	\$38.59	7A	4V	8Y	View
Chelan	Glaziers	Journey Level	\$31.59	7L	4L		View
Chelan	Heat & Frost Insulators And Asbestos Workers	Journeyman	\$76.61	5J	4H		View
Chelan	Heating Equipment Mechanics	Journey Level	\$56.61	6Z	1B		View
Chelan	Hod Carriers & Mason Tenders	Journey Level	\$42.30	7A	4V	8Y	View
Chelan	Industrial Power Vacuum	Journey Level	\$13.50		1		View

	Cleaner						
Chelan	Inland Boatmen	Journey Level	\$13.50		1		View
Chelan	Inspection/Cleaning/Sealing Of Sewer & Water Systems By Remote Control	Cleaner Operator, Foamer Operator	\$13.50		1		View
Chelan	Inspection/Cleaning/Sealing Of Sewer & Water Systems By Remote Control	Grout Truck Operator	\$13.50		1		View
Chelan	Inspection/Cleaning/Sealing Of Sewer & Water Systems By Remote Control	Head Operator	\$13.50		1		View
Chelan	Inspection/Cleaning/Sealing Of Sewer & Water Systems By Remote Control	Technician	\$13.50		1		View
Chelan	Inspection/Cleaning/Sealing Of Sewer & Water Systems By Remote Control	Tv Truck Operator	\$13.50		1		View
Chelan	Insulation Applicators	Journey Level	\$47.37	7E	4X	8N	View
Chelan	Ironworkers	Journeyman	\$63.06	7N	10		View
Chelan	Laborers	Erosion Control Worker	\$41.09	7A	4V	8Y	View
Chelan	Laborers	Air, Gas Or Electric Vibrating Screed	\$41.09	7A	4V	8Y	View
Chelan	Laborers	Airtrac Drill Operator	\$42.30	7A	4V	8Y	View
Chelan	Laborers	Ballast Regular Machine	\$41.09	7A	4V	8Y	View
Chelan	Laborers	Batch Weighman	\$38.59	7A	4V	8Y	View
Chelan	Laborers	Brick Pavers	\$41.09	7A	4V	8Y	View
Chelan	Laborers	Bruch Cutter	\$41.09	7A	4V	8Y	View
Chelan	Laborers	Brush Hog Feeder	\$41.09	7A	4V	8Y	View
Chelan	Laborers	Burner	\$41.09	7A	4V	8Y	View
Chelan	Laborers	Caisson Worker	\$42.30	7A	4V	8Y	View
Chelan	Laborers	Carpenter Tender	\$41.09	7A	4V	8Y	View
Chelan	Laborers	Cement Dumper-paving	\$41.79	7A	4V	8Y	View
Chelan	Laborers	Cement Finisher Tender	\$41.09	7A	4V	8Y	View
Chelan	Laborers	Change House Or Dry Shack	\$41.09	7A	4V	8Y	View
Chelan	Laborers	Chipping Gun (30 Lbs. And Over)	\$41.79	7A	4V	8Y	View
Chelan	Laborers	Chipping Gun (Under 30 Lbs.)	\$41.09	7A	4V	8Y	View
Chelan	Laborers	Choker Setter	\$41.09	7A	4V	8Y	View
Chelan	Laborers	Chuck Tender	\$41.09	7A	4V	8Y	View
Chelan	Laborers	Clary Power Spreader	\$41.79	7A	4V	8Y	View
Chelan	Laborers	Clean-up Laborer	\$41.09	7A	4V	8Y	View
Chelan	Laborers	Concrete Dumper/Chute Operator	\$41.79	7A	4V	8Y	View
Chelan	Laborers	Concrete Form Stripper	\$41.09	7A	4V	8Y	View
Chelan	Laborers	Concrete Placement Crew	\$41.79	7A	4V	8Y	View
Chelan	Laborers	Concrete Saw Operator/Core Driller	\$41.79	7A	4V	8Y	View
Chelan	Laborers	Crusher Feeder	\$38.59	7A	4V	8Y	View
Chelan	Laborers	Curing Laborer	\$41.09	7A	4V	8Y	View
Chelan	Laborers	Demolition: Wrecking & Moving	\$41.09	7A	4V	8Y	View

		(Incl. Charred Material)					
Chelan	Laborers	Ditch Digger	\$41.09	7A	4V	8Y	View
Chelan	Laborers	Diver	\$42.30	7A	4V	8Y	View
Chelan	Laborers	Drill Operator (Hydraulic, Diamond)	\$41.79	7A	4V	8Y	View
Chelan	Laborers	Dry Stack Walls	\$41.09	7A	4V	8Y	View
Chelan	Laborers	Dump Person	\$41.09	7A	4V	8Y	View
Chelan	Laborers	Epoxy Technician	\$41.09	7A	4V	8Y	View
Chelan	Laborers	Faller & Bucker Chain Saw	\$41.79	7A	4V	8Y	View
Chelan	Laborers	Fine Graders	\$41.09	7A	4V	8Y	View
Chelan	Laborers	Firewatch	\$38.59	7A	4V	8Y	View
Chelan	Laborers	Form Setter	\$41.09	7A	4V	8Y	View
Chelan	Laborers	Gabian Basket Building	\$41.09	7A	4V	8Y	View
Chelan	Laborers	Gaurdrail Erector	\$41.09	7A	4V	8Y	View
Chelan	Laborers	General Laborer	\$41.09	7A	4V	8Y	View
Chelan	Laborers	Grade Checker & Transit Person	\$42.30	7A	4V	8Y	View
Chelan	Laborers	Grinders	\$41.09	7A	4V	8Y	View
Chelan	Laborers	Grout Machine Tender	\$41.09	7A	4V	8Y	View
Chelan	Laborers	Groutmen (Pressure) Including Post Tension Beams	\$41.79	7A	4V	8Y	View
Chelan	Laborers	Hazardous Waste Worker (Level A)	\$42.30	7A	4V	8Y	View
Chelan	Laborers	Hazardous Waste Worker (Level B)	\$41.79	7A	4V	8Y	View
Chelan	Laborers	Hazardous Waste Worker (Level C)	\$41.09	7A	4V	8Y	View
Chelan	Laborers	High Scaler	\$42.30	7A	4V	8Y	View
Chelan	Laborers	Jackhammer	\$41.79	7A	4V	8Y	View
Chelan	Laborers	Laserbeam Operator	\$41.79	7A	4V	8Y	View
Chelan	Laborers	Maintenance Person	\$41.09	7A	4V	8Y	View
Chelan	Laborers	Manhole Builder-Mudman	\$41.79	7A	4V	8Y	View
Chelan	Laborers	Material Yard Person	\$41.09	7A	4V	8Y	View
Chelan	Laborers	Motorman-Dinky Locomotive	\$41.79	7A	4V	8Y	View
Chelan	Laborers	Nozzleman (Concrete Pump, Green Cutter When Using Combination Of High Pressure Air & Water On Concrete & Rock, Sandblast, Gunite, Shotcrete, Water Blaster, Vacuum Blaster)	\$41.79	7A	4V	8Y	View
Chelan	Laborers	Pavement Breaker	\$41.79	7A	4V	8Y	View
Chelan	Laborers	Pilot Car	\$38.59	7A	4V	8Y	View
Chelan	Laborers	Pipe Later Lead	\$42.30	7A	4V	8Y	View
Chelan	Laborers	Pipe Layer/Tailor	\$41.79	7A	4V	8Y	View
Chelan	Laborers	Pipe Pot Tender	\$41.79	7A	4V	8Y	View
Chelan	Laborers	Pipe Reliner	\$41.79	7A	4V	8Y	View
Chelan	Laborers	Pipe Wrapper	\$41.79	7A	4V	8Y	View
Chelan	Laborers	Pot Tender	\$41.09	7A	4V	8Y	View

Chelan	Laborers	Powderman	\$42.30	7A	4V	8Y	View
Chelan	Laborers	Powderman's Helper	\$41.09	7A	4V	8Y	View
Chelan	Laborers	Power Jacks	\$41.79	7A	4V	8Y	View
Chelan	Laborers	Railroad Spike Puller - Power	\$41.79	7A	4V	8Y	View
Chelan	Laborers	Raker - Asphalt	\$42.30	7A	4V	8Y	View
Chelan	Laborers	Re-timberman	\$42.30	7A	4V	8Y	View
Chelan	Laborers	Remote Equipment Operator	\$41.79	7A	4V	8Y	View
Chelan	Laborers	Rigger/Signal Person	\$41.79	7A	4V	8Y	View
Chelan	Laborers	Rip Rap Person	\$41.09	7A	4V	8Y	View
Chelan	Laborers	Rivet Buster	\$41.79	7A	4V	8Y	View
Chelan	Laborers	Rodder	\$41.79	7A	4V	8Y	View
Chelan	Laborers	Scaffold Erector	\$41.09	7A	4V	8Y	View
Chelan	Laborers	Scale Person	\$41.09	7A	4V	8Y	View
Chelan	Laborers	Sloper (Over 20")	\$41.79	7A	4V	8Y	View
Chelan	Laborers	Sloper Sprayer	\$41.09	7A	4V	8Y	View
Chelan	Laborers	Spreader (Concrete)	\$41.79	7A	4V	8Y	View
Chelan	Laborers	Stake Hopper	\$41.09	7A	4V	8Y	View
Chelan	Laborers	Stock Piler	\$41.09	7A	4V	8Y	View
Chelan	Laborers	Tamper & Similar Electric, Air & Gas Operated Tools	\$41.79	7A	4V	8Y	View
Chelan	Laborers	Tamper (Multiple & Self-propelled)	\$41.79	7A	4V	8Y	View
Chelan	Laborers	Timber Person - Sewer (Lagger, Shorer & Cribber)	\$41.79	7A	4V	8Y	View
Chelan	Laborers	Toolroom Person (at Jobsite)	\$41.09	7A	4V	8Y	View
Chelan	Laborers	Topper	\$41.09	7A	4V	8Y	View
Chelan	Laborers	Track Laborer	\$41.09	7A	4V	8Y	View
Chelan	Laborers	Track Liner (Power)	\$41.79	7A	4V	8Y	View
Chelan	Laborers	Traffic Control Laborer	\$40.90	7A	4V	9C	View
Chelan	Laborers	Traffic Control Supervisor	\$40.90	7A	4V	9C	View
Chelan	Laborers	Truck Spotter	\$41.09	7A	4V	8Y	View
Chelan	Laborers	Tugger Operator	\$41.79	7A	4V	8Y	View
Chelan	Laborers	Tunnel Work-Guage and Lock Tender	\$42.40	7A	4V	8Y	View
Chelan	Laborers	Tunnel Work-Guage and Lock Tender	\$42.40	7A	4V	8Y	View
Chelan	Laborers	Vibrator	\$41.79	7A	4V	8Y	View
Chelan	Laborers	Vinyl Seamer	\$41.09	7A	4V	8Y	View
Chelan	Laborers	Watchmen	\$35.20	7A	4V	8Y	View
Chelan	Laborers	Welder	\$41.79	7A	4V	8Y	View
Chelan	Laborers	Well Point Laborer	\$41.79	7A	4V	8Y	View
Chelan	Laborers	Window Washer/Cleaner	\$35.20	7A	4V	8Y	View
Chelan	Laborers - Underground Sewer & Water	General Laborer & Topman	\$41.09	7A	4V	8Y	View
Chelan	Laborers - Underground Sewer & Water	Pipe Layer	\$41.79	7A	4V	8Y	View
Chelan	Landscape Construction	Landscape Construction/landscaping Or Planting Laborers	\$35.20	7A	4V	8Y	View

Chelan	Landscape Construction	Landscape Operator	\$66.05	7A	3K	8X	View
Chelan	Landscape Maintenance	Groundskeeper	\$13.50		1		View
Chelan	Lathers	Journey Level	\$47.37	7E	4X	8N	View
Chelan	Marble Setters	Journey Level	\$50.44	5A	1M		View
Chelan	Metal Fabrication (In Shop)	Fitter	\$15.04		1		View
Chelan	Metal Fabrication (In Shop)	Laborer	\$13.50		1		View
Chelan	Metal Fabrication (In Shop)	Machine Operator	\$13.50		1		View
Chelan	Metal Fabrication (In Shop)	Painter	\$13.50		1		View
Chelan	Metal Fabrication (In Shop)	Welder	\$13.50		1		View
Chelan	Millwright	Journey Level	\$66.83	7E	4X	8N	View
Chelan	Modular Buildings	Journey Level	\$14.11		1		View
Chelan	Painters	Commercial Painter	\$36.87	6Z	1W		View
Chelan	Painters	Industrial Painter	\$40.27	6Z	1W	9D	View
Chelan	Pile Driver	Journey Level	\$62.69	7A	4C		View
Chelan	Plasterers	Journey Level	\$42.88	7K	1N		View
Chelan	Playground & Park Equipment Installers	Journey Level	\$13.50		1		View
Chelan	Plumbers & Pipefitters	Journey Level	\$59.87	5A	1G		View
Chelan	Power Equipment Operators	Asphalt Plant Operators	\$67.16	7A	3K	8X	View
Chelan	Power Equipment Operators	Assistant Engineer	\$63.17	7A	3K	8X	View
Chelan	Power Equipment Operators	Barrier Machine (zipper)	\$66.57	7A	3K	8X	View
Chelan	Power Equipment Operators	Batch Plant Operator: concrete	\$66.57	7A	3K	8X	View
Chelan	Power Equipment Operators	Bobcat	\$63.17	7A	3K	8X	View
Chelan	Power Equipment Operators	Brokk - Remote Demolition Equipment	\$63.17	7A	3K	8X	View
Chelan	Power Equipment Operators	Brooms	\$63.17	7A	3K	8X	View
Chelan	Power Equipment Operators	Bump Cutter	\$66.57	7A	3K	8X	View
Chelan	Power Equipment Operators	Cableways	\$67.16	7A	3K	8X	View
Chelan	Power Equipment Operators	Chipper	\$66.57	7A	3K	8X	View
Chelan	Power Equipment Operators	Compressor	\$63.17	7A	3K	8X	View
Chelan	Power Equipment Operators	Concrete Finish Machine - Laser Screed	\$63.17	7A	3K	8X	View
Chelan	Power Equipment Operators	Concrete Pump - Mounted Or Trailer High Pressure Line Pump, Pump High Pressure	\$66.05	7A	3K	8X	View
Chelan	Power Equipment Operators	Concrete Pump: Truck Mount With Boom Attachment Over 42 M	\$67.16	7A	3K	8X	View
Chelan	Power Equipment Operators	Concrete Pump: Truck Mount With Boom Attachment Up To 42m	\$66.57	7A	3K	8X	View
Chelan	Power Equipment Operators	Conveyors	\$66.05	7A	3K	8X	View
Chelan	Power Equipment Operators	Cranes friction: 200 tons and over	\$69.20	7A	3K	8X	View
Chelan	Power Equipment Operators	Cranes: 100 tons through 199 tons, or 150' of boom (including jib with attachments)	\$67.84	7A	3K	8X	View
Chelan	Power Equipment Operators	Cranes: 20 Tons Through 44 Tons With Attachments	\$66.57	7A	3K	8X	View

Chelan	Power Equipment Operators	Cranes: 200 tons- 299 tons, or 250' of boom including jib with attachments	\$68.53	7A	3K	8X	View
Chelan	Power Equipment Operators	Cranes: 300 tons and over or 300' of boom including jib with attachments	\$69.20	7A	3K	8X	View
Chelan	Power Equipment Operators	Cranes: 45 Tons Through 99 Tons, Under 150' Of Boom (including Jib With Attachments)	\$67.16	7A	3K	8X	View
Chelan	Power Equipment Operators	Cranes: A-frame - 10 Tons And Under	\$63.17	7A	3K	8X	View
Chelan	Power Equipment Operators	Cranes: Friction cranes through 199 tons	\$68.53	7A	3K	8X	View
Chelan	Power Equipment Operators	Cranes: through 19 tons with attachments, A-frame over 10 tons	\$66.05	7A	3K	8X	View
Chelan	Power Equipment Operators	Crusher	\$66.57	7A	3K	8X	View
Chelan	Power Equipment Operators	Deck Engineer/Deck Winches (power)	\$66.57	7A	3K	8X	View
Chelan	Power Equipment Operators	Derricks, On Building Work	\$67.16	7A	3K	8X	View
Chelan	Power Equipment Operators	Dozers D-9 & Under	\$66.05	7A	3K	8X	View
Chelan	Power Equipment Operators	Drill Oilers: Auger Type, Truck Or Crane Mount	\$66.05	7A	3K	8X	View
Chelan	Power Equipment Operators	Drilling Machine	\$67.84	7A	3K	8X	View
Chelan	Power Equipment Operators	Elevator And Man-lift: Permanent And Shaft Type	\$63.17	7A	3K	8X	View
Chelan	Power Equipment Operators	Finishing Machine, Bidwell And Gamaco & Similar Equipment	\$66.57	7A	3K	8X	View
Chelan	Power Equipment Operators	Forklift: 3000 Lbs And Over With Attachments	\$66.05	7A	3K	8X	View
Chelan	Power Equipment Operators	Forklifts: Under 3000 Lbs. With Attachments	\$63.17	7A	3K	8X	View
Chelan	Power Equipment Operators	Grade Engineer: Using Blue Prints, Cut Sheets, Etc	\$66.57	7A	3K	8X	View
Chelan	Power Equipment Operators	Gradechecker/Stakeman	\$63.17	7A	3K	8X	View
Chelan	Power Equipment Operators	Guardrail Punch	\$66.57	7A	3K	8X	View
Chelan	Power Equipment Operators	Hard Tail End Dump Articulating Off- Road Equipment 45 Yards. & Over	\$67.16	7A	3K	8X	View
Chelan	Power Equipment Operators	Hard Tail End Dump Articulating Off-road Equipment Under 45 Yards	\$66.57	7A	3K	8X	View
Chelan	Power Equipment Operators	Horizontal/Directional Drill Locator	\$66.05	7A	3K	8X	View
Chelan	Power Equipment Operators	Horizontal/Directional Drill Operator	\$66.57	7A	3K	8X	View
Chelan	Power Equipment Operators	Hydralifts/Boom Trucks Over 10 Tons	\$66.05	7A	3K	8X	View
Chelan	Power Equipment Operators	Hydralifts/Boom Trucks, 10 Tons And Under	\$63.17	7A	3K	8X	View
Chelan	Power Equipment Operators	Loader, Overhead 8 Yards. & Over	\$67.84	7A	3K	8X	View

Chelan	Power Equipment Operators	Loader, Overhead, 6 Yards. But Not Including 8 Yards	\$67.16	7A	3K	8X	View
Chelan	Power Equipment Operators	Loaders, Overhead Under 6 Yards	\$66.57	7A	3K	8X	View
Chelan	Power Equipment Operators	Loaders, Plant Feed	\$66.57	7A	3K	8X	View
Chelan	Power Equipment Operators	Loaders: Elevating Type Belt	\$66.05	7A	3K	8X	View
Chelan	Power Equipment Operators	Locomotives, All	\$66.57	7A	3K	8X	View
Chelan	Power Equipment Operators	Material Transfer Device	\$66.57	7A	3K	8X	View
Chelan	Power Equipment Operators	Mechanics, All (leadmen - \$0.50 Per Hour Over Mechanic)	\$67.84	7A	3K	8X	View
Chelan	Power Equipment Operators	Motor Patrol Graders	\$67.16	7A	3K	8X	View
Chelan	Power Equipment Operators	Mucking Machine, Mole, Tunnel Drill, Boring, Road Header And/or Shield	\$67.16	7A	3K	8X	View
Chelan	Power Equipment Operators	Oil Distributors, Blower Distribution & Mulch Seeding Operator	\$63.17	7A	3K	8X	View
Chelan	Power Equipment Operators	Outside Hoists (Elevators And Manlifts), Air Tuggers, Strato	\$66.05	7A	3K	8X	View
Chelan	Power Equipment Operators	Overhead, Bridge Type Crane: 20 Tons Through 44 Tons	\$66.57	7A	3K	8X	View
Chelan	Power Equipment Operators	Overhead, Bridge Type: 100 Tons And Over	\$67.84	7A	3K	8X	View
Chelan	Power Equipment Operators	Overhead, Bridge Type: 45 Tons Through 99 Tons	\$67.16	7A	3K	8X	View
Chelan	Power Equipment Operators	Pavement Breaker	\$63.17	7A	3K	8X	View
Chelan	Power Equipment Operators	Pile Driver (other Than Crane Mount)	\$66.57	7A	3K	8X	View
Chelan	Power Equipment Operators	Plant Oiler - Asphalt, Crusher	\$66.05	7A	3K	8X	View
Chelan	Power Equipment Operators	Posthole Digger, Mechanical	\$63.17	7A	3K	8X	View
Chelan	Power Equipment Operators	Power Plant	\$63.17	7A	3K	8X	View
Chelan	Power Equipment Operators	Pumps - Water	\$63.17	7A	3K	8X	View
Chelan	Power Equipment Operators	Quad 9, Hd 41, D10 And Over	\$67.16	7A	3K	8X	View
Chelan	Power Equipment Operators	Quick Tower - No Cab, Under 100 Feet In Height Based To Boom	\$63.17	7A	3K	8X	View
Chelan	Power Equipment Operators	Remote Control Operator On Rubber Tired Earth Moving Equipment	\$67.16	7A	3K	8X	View
Chelan	Power Equipment Operators	Rigger and Bellman	\$63.17	7A	3K	8X	View
Chelan	Power Equipment Operators	Rigger/Signal Person, Bellman (Certified)	\$66.05	7A	3K	8X	View
Chelan	Power Equipment Operators	Rollagon	\$67.16	7A	3K	8X	View
Chelan	Power Equipment Operators	Roller, Other Than Plant Mix	\$63.17	7A	3K	8X	View
Chelan	Power Equipment Operators	Roller, Plant Mix Or Multi-lift Materials	\$66.05	7A	3K	8X	View
Chelan	Power Equipment Operators	Roto-mill, Roto-grinder	\$66.57	7A	3K	8X	View
Chelan	Power Equipment Operators	Saws - Concrete	\$66.05	7A	3K	8X	View
Chelan	Power Equipment Operators	Scraper, Self Propelled Under 45 Yards	\$66.57	7A	3K	8X	View
Chelan	Power Equipment Operators	Scrapers - Concrete & Carry All	\$66.05	7A	3K	8X	View

Chelan	Power Equipment Operators	Scrapers, Self-propelled: 45 Yards And Over	\$67.16	7A	3K	8X	View
Chelan	Power Equipment Operators	Service Engineers - Equipment	\$66.05	7A	3K	8X	View
Chelan	Power Equipment Operators	Shotcrete/Gunite Equipment	\$63.17	7A	3K	8X	View
Chelan	Power Equipment Operators	Shovel , Excavator, Backhoe, Tractors Under 15 Metric Tons	\$66.05	7A	3K	8X	View
Chelan	Power Equipment Operators	Shovel, Excavator, Backhoe: Over 30 Metric Tons To 50 Metric Tons	\$67.16	7A	3K	8X	View
Chelan	Power Equipment Operators	Shovel, Excavator, Backhoes, Tractors: 15 To 30 Metric Tons	\$66.57	7A	3K	8X	View
Chelan	Power Equipment Operators	Shovel, Excavator, Backhoes: Over 50 Metric Tons To 90 Metric Tons	\$67.84	7A	3K	8X	View
Chelan	Power Equipment Operators	Shovel, Excavator, Backhoes: Over 90 Metric Tons	\$68.53	7A	3K	8X	View
Chelan	Power Equipment Operators	Slipform Pavers	\$67.16	7A	3K	8X	View
Chelan	Power Equipment Operators	Spreader, Topsider & Screedman	\$67.16	7A	3K	8X	View
Chelan	Power Equipment Operators	Subgrader Trimmer	\$66.57	7A	3K	8X	View
Chelan	Power Equipment Operators	Tower Bucket Elevators	\$66.05	7A	3K	8X	View
Chelan	Power Equipment Operators	Tower Crane Up To 175' In Height Base To Boom	\$67.84	7A	3K	8X	View
Chelan	Power Equipment Operators	Tower Crane: over 175' through 250' in height, base to boom	\$68.53	7A	3K	8X	View
Chelan	Power Equipment Operators	Tower Cranes: over 250' in height from base to boom	\$69.20	7A	3K	8X	View
Chelan	Power Equipment Operators	Transporters, All Track Or Truck Type	\$67.16	7A	3K	8X	View
Chelan	Power Equipment Operators	Trenching Machines	\$66.05	7A	3K	8X	View
Chelan	Power Equipment Operators	Truck Crane Oiler/driver - 100 Tons And Over	\$66.57	7A	3K	8X	View
Chelan	Power Equipment Operators	Truck Crane Oiler/Driver Under 100 Tons	\$66.05	7A	3K	8X	View
Chelan	Power Equipment Operators	Truck Mount Portable Conveyor	\$66.57	7A	3K	8X	View
Chelan	Power Equipment Operators	Welder	\$67.16	7A	3K	8X	View
Chelan	Power Equipment Operators	Wheel Tractors, Farmall Type	\$63.17	7A	3K	8X	View
Chelan	Power Equipment Operators	Yo Yo Pay Dozer	\$66.57	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Asphalt Plant Operators	\$67.16	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Assistant Engineer	\$63.17	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Barrier Machine (zipper)	\$66.57	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Batch Plant Operator, Concrete	\$66.57	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Bobcat	\$63.17	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Brokk - Remote Demolition Equipment	\$63.17	7A	3K	8X	View
Chelan	Power Equipment Operators-	Brooms	\$63.17	7A	3K	8X	View

	Underground Sewer & Water						
Chelan	Power Equipment Operators-Underground Sewer & Water	Bump Cutter	\$66.57	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Cableways	\$67.16	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Chipper	\$66.57	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Compressor	\$63.17	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Concrete Finish Machine - Laser Screed	\$63.17	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Concrete Pump - Mounted Or Trailer High Pressure Line Pump, Pump High Pressure	\$66.05	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Concrete Pump: Truck Mount With Boom Attachment Over 42 M	\$67.16	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Concrete Pump: Truck Mount With Boom Attachment Up To 42m	\$66.57	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Conveyors	\$66.05	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Cranes friction: 200 tons and over	\$69.20	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Cranes: 100 tons through 199 tons, or 150' of boom (including jib with attachments)	\$67.84	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Cranes: 20 Tons Through 44 Tons With Attachments	\$66.57	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Cranes: 200 tons- 299 tons, or 250' of boom including jib with attachments	\$68.53	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Cranes: 300 tons and over or 300' of boom including jib with attachments	\$69.20	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Cranes: 45 Tons Through 99 Tons, Under 150' Of Boom (including Jib With Attachments)	\$67.16	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Cranes: A-frame - 10 Tons And Under	\$63.17	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Cranes: Friction cranes through 199 tons	\$68.53	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Cranes: through 19 tons with attachments, A-frame over 10 tons	\$66.05	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Crusher	\$66.57	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Deck Engineer/Deck Winches (power)	\$66.57	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Derricks, On Building Work	\$67.16	7A	3K	8X	View
Chelan	Power Equipment Operators-	Dozers D-9 & Under	\$66.05	7A	3K	8X	View

	Underground Sewer & Water						
Chelan	Power Equipment Operators-Underground Sewer & Water	Drill Oilers: Auger Type, Truck Or Crane Mount	\$66.05	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Drilling Machine	\$67.84	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Elevator And Man-lift: Permanent And Shaft Type	\$63.17	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Finishing Machine, Bidwell And Gamaco & Similar Equipment	\$66.57	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Forklift: 3000 Lbs And Over With Attachments	\$66.05	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Forklifts: Under 3000 Lbs. With Attachments	\$63.17	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Grade Engineer: Using Blue Prints, Cut Sheets, Etc	\$66.57	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Gradechecker/Stakeman	\$63.17	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Guardrail Punch	\$66.57	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Hard Tail End Dump Articulating Off- Road Equipment 45 Yards. & Over	\$67.16	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Hard Tail End Dump Articulating Off-road Equipment Under 45 Yards	\$66.57	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Horizontal/Directional Drill Locator	\$66.05	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Horizontal/Directional Drill Operator	\$66.57	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Hydralifts/Boom Trucks Over 10 Tons	\$66.05	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Hydralifts/Boom Trucks, 10 Tons And Under	\$63.17	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Loader, Overhead 8 Yards. & Over	\$67.84	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Loader, Overhead, 6 Yards. But Not Including 8 Yards	\$67.16	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Loaders, Overhead Under 6 Yards	\$66.57	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Loaders, Plant Feed	\$66.57	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Loaders: Elevating Type Belt	\$66.05	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Locomotives, All	\$66.57	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Material Transfer Device	\$66.57	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Mechanics, All (leadmen - \$0.50 Per Hour Over Mechanic)	\$67.84	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Motor Patrol Graders	\$67.16	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Mucking Machine, Mole, Tunnel Drill, Boring, Road Header	\$67.16	7A	3K	8X	View

		And/or Shield					
Chelan	Power Equipment Operators-Underground Sewer & Water	Oil Distributors, Blower Distribution & Mulch Seeding Operator	\$63.17	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Outside Hoists (Elevators And Manlifts), Air Tuggers, Strato	\$66.05	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Overhead, Bridge Type Crane: 20 Tons Through 44 Tons	\$66.57	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Overhead, Bridge Type: 100 Tons And Over	\$67.84	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Overhead, Bridge Type: 45 Tons Through 99 Tons	\$67.16	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Pavement Breaker	\$63.17	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Pile Driver (other Than Crane Mount)	\$66.57	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Plant Oiler - Asphalt, Crusher	\$66.05	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Posthole Digger, Mechanical	\$63.17	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Power Plant	\$63.17	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Pumps - Water	\$63.17	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Quad 9, Hd 41, D10 And Over	\$67.16	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Quick Tower - No Cab, Under 100 Feet In Height Based To Boom	\$63.17	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Remote Control Operator On Rubber Tired Earth Moving Equipment	\$67.16	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Rigger and Bellman	\$63.17	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Rigger/Signal Person, Bellman (Certified)	\$66.05	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Rollagon	\$67.16	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Roller, Other Than Plant Mix	\$63.17	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Roller, Plant Mix Or Multi-lift Materials	\$66.05	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Roto-mill, Roto-grinder	\$66.57	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Saws - Concrete	\$66.05	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Scraper, Self Propelled Under 45 Yards	\$66.57	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Scrapers - Concrete & Carry All	\$66.05	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Scrapers, Self-propelled: 45 Yards And Over	\$67.16	7A	3K	8X	View
Chelan	Power Equipment Operators-	Service Engineers - Equipment	\$66.05	7A	3K	8X	View

	Underground Sewer & Water						
Chelan	Power Equipment Operators-Underground Sewer & Water	Shotcrete/Gunite Equipment	\$63.17	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Shovel , Excavator, Backhoe, Tractors Under 15 Metric Tons	\$66.05	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Shovel, Excavator, Backhoe: Over 30 Metric Tons To 50 Metric Tons	\$67.16	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Shovel, Excavator, Backhoes, Tractors: 15 To 30 Metric Tons	\$66.57	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Shovel, Excavator, Backhoes: Over 50 Metric Tons To 90 Metric Tons	\$67.84	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Shovel, Excavator, Backhoes: Over 90 Metric Tons	\$68.53	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Slipform Pavers	\$67.16	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Spreader, Topsider & Screedman	\$67.16	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Subgrader Trimmer	\$66.57	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Tower Bucket Elevators	\$66.05	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Tower Crane Up To 175' In Height Base To Boom	\$67.84	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Tower Crane: over 175' through 250' in height, base to boom	\$68.53	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Tower Cranes: over 250' in height from base to boom	\$69.20	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Transporters, All Track Or Truck Type	\$67.16	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Trenching Machines	\$66.05	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Truck Crane Oiler/driver - 100 Tons And Over	\$66.57	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Truck Crane Oiler/Driver Under 100 Tons	\$66.05	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Truck Mount Portable Conveyor	\$66.57	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Welder	\$67.16	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Wheel Tractors, Farmall Type	\$63.17	7A	3K	8X	View
Chelan	Power Equipment Operators-Underground Sewer & Water	Yo Yo Pay Dozer	\$66.57	7A	3K	8X	View
Chelan	Power Line Clearance Tree Trimmers	Journey Level In Charge	\$50.96	5A	4A		View
Chelan	Power Line Clearance Tree Trimmers	Spray Person	\$48.35	5A	4A		View
Chelan	Power Line Clearance Tree Trimmers	Tree Equipment Operator	\$50.96	5A	4A		View
Chelan	Power Line Clearance Tree	Tree Trimmer	\$45.54	5A	4A		View

	Trimmers					
Chelan	Power Line Clearance Tree Trimmers	Tree Trimmer Groundperson	\$34.51	5A	4A	View
Chelan	Refrigeration & Air Conditioning Mechanics	Journey Level	\$59.87	5A	1G	View
Chelan	Residential Brick Mason	Journey Level	\$19.38		1	View
Chelan	Residential Carpenters	Journey Level	\$16.39		1	View
Chelan	Residential Cement Masons	Journey Level	\$15.50		1	View
Chelan	Residential Drywall Applicators	Journey Level	\$25.84		1	View
Chelan	Residential Drywall Tapers	Journey Level	\$17.06		1	View
Chelan	Residential Electricians	Journey Level	\$22.02		1	View
Chelan	Residential Glaziers	Journey Level	\$16.50		1	View
Chelan	Residential Insulation Applicators	Journey Level	\$14.86		1	View
Chelan	Residential Laborers	Journey Level	\$19.06		1	View
Chelan	Residential Marble Setters	Journey Level	\$15.91		1	View
Chelan	Residential Painters	Journey Level	\$25.01		1	View
Chelan	Residential Plumbers & Pipefitters	Journey Level	\$20.67		1	View
Chelan	Residential Refrigeration & Air Conditioning Mechanics	Journey Level	\$17.25		1	View
Chelan	Residential Sheet Metal Workers	Journey Level (Field or Shop)	\$56.61	5I	1B	View
Chelan	Residential Soft Floor Layers	Journey Level	\$13.64		1	View
Chelan	Residential Sprinkler Fitters (Fire Protection)	Journey Level	\$17.71		1	View
Chelan	Residential Stone Masons	Journey Level	\$19.38		1	View
Chelan	Residential Terrazzo Workers	Journey Level	\$14.86		1	View
Chelan	Residential Terrazzo/Tile Finishers	Journey Level	\$13.50		1	View
Chelan	Residential Tile Setters	Journey Level	\$14.86		1	View
Chelan	Roofers	Journey Level	\$41.09	5I	1R	View
Chelan	Roofers	Using Irritable Bituminous Materials	\$43.09	5I	1R	View
Chelan	Sheet Metal Workers	Journey Level (Field or Shop)	\$56.61	6Z	1B	View
Chelan	Sign Makers & Installers (Electrical)	Journey Level	\$75.25	7F	1E	View
Chelan	Sign Makers & Installers (Non-Electrical)	Journey Level	\$17.48		1	View
Chelan	Soft Floor Layers	Journey Level	\$15.79		1	View
Chelan	Solar Controls For Windows	Journey Level	\$13.50		1	View
Chelan	Sprinkler Fitters (Fire Protection)	Journey Level	\$56.82	7J	1R	View
Chelan	Stage Rigging Mechanics (Non Structural)	Journey Level	\$13.50		1	View
Chelan	Stone Masons	Journey Level	\$50.44	5A	1M	View
Chelan	Street And Parking Lot Sweeper Workers	Journey Level	\$20.00		1	View
Chelan	Surveyors	Assistant Construction Site Surveyor	\$66.05	7A	3K	8X View
Chelan	Surveyors	Chainman	\$63.17	7A	3K	8X View

Chelan	Surveyors	Construction Site Surveyor	\$67.16	7A	3K	8X	View
Chelan	Telecommunication Technicians	Telecom Technician Journey Level	\$45.23	5B	1B		View
Chelan	Telephone Line Construction - Outside	Cable Splicer	\$41.81	5A	2B		View
Chelan	Telephone Line Construction - Outside	Hole Digger/Ground Person	\$23.53	5A	2B		View
Chelan	Telephone Line Construction - Outside	Installer (Repairer)	\$40.09	5A	2B		View
Chelan	Telephone Line Construction - Outside	Special Aparatus Installer I	\$41.81	5A	2B		View
Chelan	Telephone Line Construction - Outside	Special Apparatus Installer II	\$40.99	5A	2B		View
Chelan	Telephone Line Construction - Outside	Telephone Equipment Operator (Heavy)	\$41.81	5A	2B		View
Chelan	Telephone Line Construction - Outside	Telephone Equipment Operator (Light)	\$38.92	5A	2B		View
Chelan	Telephone Line Construction - Outside	Telephone Lineperson	\$38.92	5A	2B		View
Chelan	Telephone Line Construction - Outside	Television Groundperson	\$22.32	5A	2B		View
Chelan	Telephone Line Construction - Outside	Television Lineperson/Installer	\$29.60	5A	2B		View
Chelan	Telephone Line Construction - Outside	Television System Technician	\$35.20	5A	2B		View
Chelan	Telephone Line Construction - Outside	Television Technician	\$31.67	5A	2B		View
Chelan	Telephone Line Construction - Outside	Tree Trimmer	\$38.92	5A	2B		View
Chelan	Terrazzo Workers	Journey Level	\$43.61	5A	1M		View
Chelan	Tile Setters	Journey Level	\$43.61	5A	1M		View
Chelan	Tile, Marble & Terrazzo Finishers	Journey Level	\$35.73	5A	1M		View
Chelan	Traffic Control Stripers	Journey Level	\$47.68	7A	1K		View
Chelan	Truck Drivers	Asphalt Mix Over 20 Yards	\$46.42	5D	1V	8M	View
Chelan	Truck Drivers	Asphalt Mix To 20 Yards	\$46.05	5D	1V	8M	View
Chelan	Truck Drivers	Dump Truck	\$46.05	5D	1V	8M	View
Chelan	Truck Drivers	Dump Truck & Trailer	\$46.42	5D	1V	8M	View
Chelan	Truck Drivers	Other Trucks	\$45.94	5D	1V	8M	View
Chelan	Truck Drivers - Ready Mix	Transit Mixers 20 yards and under	\$46.42	5D	1V	8M	View
Chelan	Truck Drivers - Ready Mix	Transit Mixers over 20 yards	\$46.75	5D	1V	8M	View
Chelan	Well Drillers & Irrigation Pump Installers	Irrigation Pump Installer	\$13.50		1		View
Chelan	Well Drillers & Irrigation Pump Installers	Oiler	\$13.50		1		View
Chelan	Well Drillers & Irrigation Pump Installers	Well Driller	\$18.00		1		View

1.00 GENERAL

This Section 01 01 00 includes project specific information, special provisions/requirements, and/or revisions to the specifications, detail drawings and other items contained in these Contract Documents. These provisions are part of the overall Contract Documents and, as such, shall be regarded in a like manner during the bidding process and during the construction phase. These special requirements shall supplement and/or supersede items of like nature in the Contract Documents as indicated herein.

2.00 PROJECT INFORMATION

The following paragraphs provide special information regarding the project.

A. Owner and Engineer

Project Owner: City of Leavenworth
700 Highway 2 / PO Box 287
Leavenworth, WA 98826
509-548-5275

Project Engineer: Varela and Associates, Inc.
W. 601 Mallon Ave., STE A
Spokane, WA 99201
(509) 328-6066

B. Project Location

The City of Leavenworth is located on US Highway 2 in Chelan County, central Washington, approximately 20 miles west of Wenatchee. The project site is located at the City's existing wastewater treatment plant in the northeastern portion of the City, at the south end of 14th Street adjacent to the north shore of the Wenatchee River. See Drawings for project location map.

C. Project Description / Base Bid and Schedules

The project consists of improvements to the City of Leavenworth's existing wastewater treatment plant. Major elements of the work include: new tertiary treatment facility, headworks equipment, clarifier mechanism replacements, centrifuge dewatering equipment, UV disinfection equipment, cross connection control system, electrical/controls upgrades, and associated demolition, earthwork, site improvement, building modifications, and temporary facilities as needed to maintain operation of the treatment plant during construction.

The proposed work consists of a Base Bid and three separate Schedules. Note, the schedules are in no particular order. The Base Bid and Schedules include, but are not limited to, the following:

Base Bid

The Base Bid shall include all work, materials, labor, equipment, etc. required to construct the wastewater treatment plant upgrades as described in these documents unless specifically included in other schedules. Work includes, but is not limited to, the following:

- Mobilization and administration;
- Demolition, site preparation, excavation, grading and site improvements; over excavation, installation of structural fill, import/export of material;
- Erosion and sediment control;
- New headwork's building influent fine screen, associated electrical and controls; associated demolition and channel/building modifications;
- Upgrades for biological phosphorus removal including control system, new concrete separation wall in existing selector tank, MLSS pumping system, mixing, associated piping, electrical and controls;
- Tertiary treatment facility including: demolition of existing parking area / retaining walls / existing features, earthwork, construction of retaining walls, foundations, pre-engineered metal building, architectural components, HVAC system, electrical, controls, site work, walkways, stairways, and all associated improvements;
- Tertiary treatment system including flocculation tanks, chemical feed system, chemical storage tanks, disc filter system, piping, walkways, appurtenances, electrical/controls, and any and all items required for a complete and fully operational phosphorus reduction treatment system meeting the specified criteria;
- Cross connection control system including pumps, tanks, piping, electrical/controls, appurtenances and skid system;
- Filter feed lift station including concrete wetwell, valve vault, submersible pump system, VFD's, electrical/controls, piping, and appurtenances;
- Process and site piping;
- Coordination w/ operation of existing facilities;
- Electrical and controls upgrades and improvements;
- Site improvements including finish grading, access road, pavement, landscaping, gravel surfaces, curbs, sidewalks including heated sections, etc.;
- Temporary facilities including operation as required to maintain full operation of the existing WWTP during construction; including construction and operation of temporary facilities including piping, pumping, electrical/controls, and any and all labor, equipment, costs or facilities;
- Any and all other items, equipment, appurtenances, labor, materials, etc. needed for a fully functional upgraded wastewater treatment plant;
- Startup, testing, owner training, commissioning, etc.

SCHEDULE A: UV SYSTEM UPGRADE

Schedule A consists of all work, material, labor, equipment, etc. required to construct a complete and fully operational UV disinfection system including, but not limited to, the following:

- Temporary UV disinfection system/facilities (including operation) and coordination with operation of existing facilities;
- Demolition including: removal and disposal of existing UV disinfection equipment, appurtenances, electrical, etc.; removal and disposal of piping, isolation gates, and level controller; demolition of interior concrete walls and slab as needed to construct the UV disinfection improvements and building improvements;
- Disassemble and reassemble 90-degree elbow as needed to allow for clearance between bottom of piping flanges and top of new floor surface;
- Building improvements including structural items, concrete walls and slabs, stairways, handrails, and architectural items;

- New UV disinfection system and appurtenances;
- Piping and valving;
- Low flow recirculation pump, pedestal, associated piping, valving, and appurtenances;
- Electrical and controls equipment;
- All items, equipment, appurtenances, accessories, labor, materials, etc. required for a complete and fully operational UV disinfection system;
- Startup, testing, owner training, and commissioning.

SCHEDULE B: MECHANICAL DEWATERING IMPROVEMENTS

Schedule B consists of all work, material, labor, equipment, etc. required to construct a complete and fully operational mechanical dewatering system and associated improvements, including, but not limited to, the following:

- Preconstruction survey of building interior;
- Temporary dewatering facilities (including operation) and coordination with operation of existing facilities;
- Demolition including: Removal and disposal of existing dewatering equipment, appurtenances, piping, electrical, and building features including existing walkway, concrete curbing, concrete columns as shown and as required for the improvements.
- Removal and disposal of existing sludge feed pump, electrical and controls panels, polymer system, and any other existing items not need for the new dewatering system;
- Rerouting sludge piping including piping, fittings, appurtenances, excavation, backfill, compaction, saw cutting, and concrete repair work as required to re-route sludge piping as shown on the drawings;
- Electrical and controls improvements;
- New lighting and building HVAC;
- New decanter centrifuge dewatering system and appurtenances including polymer feed system, sludge feed pump, steel frame/stand assembly for centrifuge and hoist/gantry, conveyor and chute tied into the existing conveyor system, piping, electrical and controls;
- Solids conveyor, chute, and custom discharge box tied into existing conveyor system
- All items, equipment, appurtenances, labor, materials, etc. required for a complete and fully operational decanter centrifuge dewatering system;
- Startup, testing, owner training, commissioning, etc.

SCHEDULE C: CLARIFIER IMPROVEMENTS

Schedule C consists of all work, material, labor, equipment, etc. required to the construct the clarifier improvements, and all associated work, including, but not limited to, the following:

- Coordination with existing facilities and operation including temporary facilities as needed;
- Removal/demolition of existing mechanisms/walkways/piping/appurtenances/electrical;
- Raising wall height of clarifiers #1 and #2 by 1’;
- New clarifier equipment including center feed mechanism and associated items, structural items, walkway, submerged effluent weir system, level control improvements, and all associated piping, electrical/controls and appurtenances;
- Sidewalk removal/replacement adjacent to and connecting Clarifiers #1 and #2;
- Site piping required to modify clarifiers #1 and #2 from peripheral feed to center feed and piping required to run clarifiers #1 and #2 in series with clarifier #3 (14” piping connecting existing CLI

pipng to CLE piping and connection detail 2/CP4). All other site piping shall be included in the base bid or other schedules;

- All items, equipment, appurtenances, labor, materials, etc. required for complete and fully operational clarifier systems;
- Startup, testing, owner training, commissioning, etc.

D. Project Funding

This project is funded by the United States Department of Agriculture Rural Development (RD) program. Neither USDA-RD nor the State of Washington nor employees are or shall be a party to this contract or any subcontract. All work performed on this project are subject to all applicable federal, state, and local laws and regulations. Funding provisions are included in the contract documents.

Third-Party Beneficiary - All parties agree that the State of Washington shall be, and is hereby, named as an express third-party beneficiary of this contract, with full rights as such.

E. Contract Award

The Work described in these Contract Documents shall be awarded to a single Contractor as described in the Instruction to Bidders. The Owner may elect to award one or more schedules in addition to the base bid. The basis of award shall be to the lowest responsive bidder of the Base Bid or Base Bid plus schedule, or schedules, to be awarded by the Owner.

F. Jurisdiction

The project is located in Chelan County and within the City of Leavenworth corporate limits.

G. Contract Time and Liquidated Damages

Contract Time and Liquidated Damages shall be as indicated in the following table. Also refer to Article 14.04 and 14.07 of the General Conditions, and Article 4 of the Agreement.

<u>Milestone</u> (see Agreement Paragraph 4.02)	<u>Contract Time</u> ⁽¹⁾	<u>Liquidated Damages</u> ⁽²⁾
Substantial Completion 1 For: Base Bid, Sch. A ⁽³⁾ (see GC 14.04)	300 calendar days	\$4,500 / calendar day
Substantial Completion 2 For: Sch. B ⁽³⁾ , Sch. C ⁽³⁾ (see GC 14.04)	100 calendar days	\$4,500 / calendar day
Readiness for Final Payment (see GC 14.07)	60 continuous calendar days after Substantial Completion is achieved	\$4,500 / calendar day

(1) If a separate Notice to Proceed (NTP) is not issued, Contract Time for Sch. B and C shall begin 300 calendar days after NTP for base bid.

- (2) *Liquidated damages are additive if multiple milestones are not met.*
- (3) *If awarded.*

The Contract Time shall be counted from the first day of on-site work and shall run continuously until all work is complete and ready for final payment in accordance with General Conditions Section 14.07.

Unless a Contract Time extension is granted by the Owner, the Contractor agrees to pay liquidated damages in the amount shown above for each calendar day required to achieve Substantial Completion and/or Readiness for Final Payment in excess of the stated Contract Time indicated in the preceding table.

The liquidated damages are anticipated to be a reasonable forecast for the harm caused by delay based on the following considerations, among others:

- a. Delay will result in additional expenses incurred by the Owner for administrative services pertaining to this contract.
- b. Additional Engineering and Inspection expenses.
- c. Potential wastewater haul charges to the Cashmere Treatment or other wastewater treatment facilities
- d. Inconvenience to City and County residences.
- e. Delay may impact additional phased work and contractual schedules
- f. The fixed amount of liquidated damages specified above in the event of delay provides the Contractor with a more accurate range of potential liability for delay as opposed to an estimation of the Owner's actual damages caused by delay, the latter being more difficult to ascertain.

F. Compliance Schedule

The City of Leavenworth is under a compliance order from the Department of Ecology to have phosphorus treatment online by August 2020. Contractor shall be advised the construction schedule is a significant concern to the Owner and poses substantial risk to the owner if not met. The Owner will be closely monitoring construction schedule and progress throughout the project and enforcing actions outlined herein if schedule is not met.

F. Deadline for Major Equipment Submittals

Many equipment items specified herein have long lead times. Submittals for all major equipment and electrical items, and any other item with a long lead time, shall be submitted to the engineer no later than 5 weeks after Contract Award.

H. Area Utilities, Coordination

The One Call phone number is shown on the Drawings. It shall be the Contractor's sole responsibility to research and determine all utilities present within the project and to coordinate construction activities with utility owners, to plan and execute his work to minimize utility service disruption, and to include any costs related to utility protection and/or repair and surface restoration in the amount bid.

I. Utility Locating and Potholing

The Contractor is solely responsible for all labor, equipment and materials required to locate existing utilities within the work area including but not limited to the following:

- Develop and implement a utility locate plan which will locate utilities within the work area;
- Where deemed needed by the Contractor, potholing to determine horizontal and vertical location of said utilities.

J. Interruptions in Water Service

In general, construction shall not cause water service interruptions except as necessary at the time of connection of the new water main to the existing water main. Work shall be planned such that disruptions are minimized in number and duration, and shall be approved with the Engineer and Owner at least 48 hours in advance.

K. Protection of the Environment

No construction related activity shall contribute to the degradation of the environment, allow material to enter surface or ground waters, or allow particulate emissions to the atmosphere, which exceed state or federal standards. Any actions that potentially allow a discharge to the state waters must have prior approval of the Environmental Protection Agency (EPA).

L. Safe Access

The contractor shall provide for the safe access to the construction site and to the contractor's records by the EPA personnel.

M. Permits / Building Permit

The Contractor shall be responsible for obtaining all required permits for this project and shall include all permit fee(s) in the amount bid except as noted. Permits to be obtained by the Contractor shall include building permits for each of the buildings and structures. Building permit fee(s) only will be reimbursed to the Contractor and shall not be included in the bid. All other permit fees shall be included in the amount bid. Contractor shall also obtain a City of Leavenworth business license.

N. Petroleum Products

Fueling and lubricating of Contractor equipment and motor vehicles shall be conducted in a manner that affords the maximum protection against spills and evaporation. Dispose of lubricants to be discarded and excess oil in accordance with approved procedures meeting federal, state and local regulations.

O. Existing WWTP and Conditions / Available Documents

Leavenworth's existing wastewater treatment plant (WWTP) was constructed in 1947 and upgraded in 1972 and 1998. The existing WWTP consists of an operations building, headworks building, mechanical dewatering building, selector and sludge storage tank, aeration basin (oxidation ditch), UV building, and three secondary clarifiers.

Construction plans for the originally constructed plant are not available. Construction plans for the 1972 and 1998 treatment plant upgrades are available upon request. They may not be complete. The Engineer and Owner make no warranty as to the adequacy or accuracy of the available construction plans.

The Bidder/Contractor shall make necessary site visit(s), review available construction plans, as well as complete any other investigation(s) and task(s) necessary in preparation of a bid in order to determine existing conditions.

P. Operation of WWTP During Const. / Temporary Facilities

It shall be the Contractor's responsibly to maintain existing WWTP operation during construction of the treatment plant improvements. See Section 01 89 00 for project phasing/sequencing requirements. Temporary facilities, piping, bypass pumping, etc. are anticipated and shall be included in the amount bid.

Q. Subsurface and Site Information / Over Excavation Requirements

A geotechnical report was prepared solely for the Owner's and Engineer's use. The geotechnical report is available upon request. The Engineer and Owner make no warranty as to the accuracy of this information. Bidder/Contractor shall make their own interpretation and conclusions on subsurface conditions, see General Conditions and Section 01 10 00.

Over excavation may be required in specified areas. See drawings.

R. Pre-Bid Meeting

A non-mandatory pre-bid meeting will be held at **10:30AM, January 9th, 2020**. The pre-bid meeting will begin at City Hall followed by a site visit.

S. Coordination with Other Projects

The Owner will be constructing a sewer main project that includes replacement of the influent main located on the WWTP site. It is anticipated this work will occur during the duration of this project. Contractor shall plan and coordinate operations to allow this work to occur. Coordination shall include: providing access, relocation of construction materials, equipment, etc. as needed, and coordination with the construction schedule including possible effect on startup items, etc. Final paving of the treatment plant site shall not occur until after the influent main work has been completed.

T. Inadvertent Discovery Plan

Contractor shall adhere to procedures and requirements in the inadvertent discovery plan included in the Contract Documents. The inadvertent discovery plan outlines procedures for treatment of archeological materials in the event they are discovered during project implementation.

U. Public Records

Owner and contractor agree that this contract and records related to performance of this contract are with limited exception, public records and subject to disclosure under the Public Records Act of the State of Washington, Chapter 42.56 RCW. Contractor acknowledges that in the event of a public records request to owner, the owner (City) may provide contractor with a copy of the public records request and the contractor shall provide copies of any records in the contractor's possession, necessary to fulfill the public records request. If the public records request is larger, contractor will provide owner with an estimate of the reasonably needed to fulfill the records request. Contractor agrees to save, hold harmless,

indemnify and defend the owner, its officers, agents, employees and elected officials from and against all claims, lawsuits, fees, penalties, and costs resulting from the owner's violation of the Public Records Act and/or contractor's failure to produce public records required under the Public Records Act. This section shall survive final acceptance of the work by owner.

V. Additional Information Concerning Site Conditions:

This section supplements Article 4 Instructions to Bidder Attachment F. A listing of reports and drawings available to Bidder and related to site conditions follows:

- Construction plans for the 1972 treatment plant upgrades
- Construction plans for the 1998 treatment plant upgrades
- Geotechnical Engineering Site Assessment for Leavenworth Waste Water Treatment Plant Upgrade – October 1997
- Geotechnical Exploration and Analysis - Leavenworth Waste Water Treatment Tertiary Treatment Plant Expansion – May 15, 2019

Available information may not be complete. The Engineer and Owner make no warranty as to the adequacy or accuracy of the available information.

W. Bidder Requirements

This section supplements bidder requirements throughout the contract documents:

- Contractor must obtain and hold a valid business license from the City of Leavenworth
- Contractor must be and remain a registered contractor in the State of Washington
- Contractor must have a Unified Business Identifier (UBI) number
- Contractor must have and maintain industrial insurance/worker's compensation coverage as required by the State of Washington
- Contractor must have and maintain an Employment Security Department account with the State of Washington
- Contractor must have a state excise tax registration number with the State of Washington
- Contractor must not be disqualified from bidding under RCW 39.06/010 of RCW 39.12.065 (3)
- Contractor must certify as required by law that they are not a willful violator of labor laws in reference to RCW 49.48..082
- Contractor, if not otherwise exempt, must certify to training related to public works and prevailing wages as required by ESSHB 1673

3.00 SUPPLEMENTS TO THE FRONTAL DOCUMENTS AND SPECIFICATIONS

Instructions to Bidders

In Paragraph 12.01 after the words "within five days" insert "or such other time as required by law"

RCW 39.30.060 - Bidder's Subcontractor List

Revise sentence before the Bidder's Subcontractor List form to read as follows:

It is the BIDDER'S sole responsibility to comply with these requirements and to properly identify self-performance or subcontractors for heating, ventilation and air conditioning, plumbing of electric. Failure to comply renders a bidder's bid nonresponsive and void.

General Conditions (EJCDC C-700)

GC-5.04 A., add the following paragraph:

7. Claims for damages or the cost of cleanup for losses caused by pollution conditions that arise from the operations of the Contractor.

GC-6.01 Paragraph B shall be replaced with the following:

- B. Work includes significant improvements to the existing wastewater treatment facility while in operation and under regulatory permit requirements. Scheduling and implementing the various tasks requires a competent resident superintendent with similar wastewater treatment related construction experience and general understanding of wastewater treatment. Superintendent may include daily operation meetings with facility operator(s), and/or coordination of special measures in anticipation on significant weekend flows among other tasks necessary to insure compliance with the City's NPDES Permit.

The Contractor shall submit proposed superintendent's resume for Owner and Engineer review and the superintendent shall attend the Preconstruction Conference. During the course of the Work the superintendent shall be onsite at all times. This superintendent shall not be replaced without written notice to Owner and Engineer.

If, in the sole opinion of the facility operator, Owner, or Engineer, the assigned superintendent does not have adequate experience, and/or is not believed to be competent for the Work, the Contractor will be notified in writing and, the Contractor shall replace the superintendent as necessary.

GC-6.20, add the following to the end of paragraph B:

Contractor voluntarily and expressly waives the immunity of Chapter 51 RCW for the purposes of the contractor's indemnification obligations under paragraph 6.20.

Agreement (EJCDC C-520); p. 6 of 6, signature line

For CONTRACTOR under Title revise language in parenthesis as follows:

(If Contractor is a corporation, including a limited liability company, a partnership, or a joint venture attach evidence of authority to sign)

Payment Bond (EJCDC C-615); p. 3 of 3

Definition of Claimant in 15.1 revise language as follows:

- 15.1 Claimant. An individual or entity having a direct contract with Contractor, or with a first-tier subcontractor of Contractor, to furnish labor, materials, or equipment, for use in the performance

of the Contract, and tax agencies of the State of Washington under chapters 50, 51 and 82 RCW. The intent of this Bond shall be to include tax agencies and

4.00 NON-STANDARD BID ITEM DESCRIPTIONS

The following bid item descriptions are non-standard bid items that generally change from project to project. Both lump sum and unit price items may be included.

Standard bid item descriptions are contained in their relative technical specification Sections. If a conflict exists, non-standard bid items descriptions in this section shall supersede standard bid item descriptions found in other Sections. These bid items may also modify applicable Detail Drawings.

The intent of this section is to describe the approximate scope for bid items. These are summary descriptions not intended to be detailed or complete itemizations of all work, materials and equipment required for the project or for individual bid items. Any item of work shown on the plans or required by the specifications, for which no bid item is provided, shall be considered incidental and included in other bid items and no additional payment will be made.

Base Bid:

Bid Item (1) All Work Not Included In Bid Items 2 – 5:

This Lump Sum bid item includes all work not specifically included in Bid Items 2 – 5 (Base Bid) and Schedules A, B, and C. It includes the complete City of Leavenworth's Wastewater Treatment Plant Improvement Project as shown in the Contract Documents. This bid item shall be full compensation, including overhead and profit, labor, materials, equipment, construction, temporary facilities, operational start-up, and any and all other items required for a complete and operational treatment facility in accordance with these Contract Documents unless specifically included in other Bid Items or Schedules.

Bid Item (2) SWPP/SPP:

This Bid Item includes all labor, materials and equipment required to plan and implement erosion and spill prevention and control measures and storm water protection during the course of the project. Temporary erosion controls may include, but are not to:

- Still Water Screening and Erosion Control Fencing
- Providing ditches, berms, culverts, and other measures to control surface water
- Building dams, settlement basins, energy dissipaters, and other measures to control downstream flows
- Controlling underground water encountered during construction
- Protecting and / or cleaning of storm water structures
- Providing wheel washing, street sweeping, or other measures to ensure a clean, dust free area.

Contractor shall coordinate this temporary work with permanent drainage and erosion control work. The Owner may require additional temporary control measures if it appears pollution or erosion may result from weather, the nature of the materials, or progress on the work. The Owner may also require permanent erosion control work to be done with or immediately after grading. When temporary control devices are no longer needed, Contractor shall remove them and finish the areas they occupied as the Owner directs. The

Contractor shall bear full responsibility for all water pollution controls in all sources or materials, disposal sites, and haul roads the Contractor provides. Nothing in this section shall relieve the Contractor from complying with other contract requirements.

Payment shall be on a Lump Sum basis and no measurement will be required.

Bid Item (3) Minor Changes

At the discretion of the Owner, payments or credits for changes amounting to \$50,000 or less may be made under this Bid Item. This procedure may be used in lieu of the more formal Change Order procedure. The Contractor will be provided a copy of the completed order of Minor Change. The agreement for the minor Change will be documented by signature of the Contractor, or notation of verbal agreement. For the purpose of providing a common Proposal for all Bidders an amount has been entered for “Minor Changes” in the Proposal to become a part of the total Bid by the Contractor.

Schedule A: UV System Upgrade:

Bid Item (A1) UV Building Demolition and Improvements:

This Lump Sum bid item is for all Work not specifically included in Bid Item A2: Schedule A Electrical, Bid Item A3: Ultraviolet Disinfection System, and which is required to complete the UV System Upgrades as shown on the Drawings and indicated in the specifications. See Section 01 01 00 Paragraph 2.00 C. for description of Schedule A work. This bid item shall be full compensation, including overhead and profit, labor, materials, equipment, construction, operational start-up, temporary UV facilities, and any and all other items needed for a complete and operational UV System in accordance with these Contract Documents unless specifically included in other Bid Items.

Bid Item (A2) Schedule A Electrical:

This Lump Sum bid item shall be full compensation, including overhead and profit, labor, materials, equipment, installation, controls, construction, operational start-up, and all other items needed for a complete and operational electrical and controls system for the UV System Upgrades in accordance with these Contract Documents.

Payment shall be on a Lump Sum basis.

Schedule B: Mechanical Dewatering Improvements:

Bid Item (B1) Dewatering Building Demolition and Improvements:

This Lump Sum bid item is for all Work not specifically included in Bid Items B2 and B3 and which is required to complete the Mechanical Dewatering Improvements as shown on the Drawings and indicated in the specifications. See Section 01 01 00 Paragraph 2.00 C. for description of Schedule B work. This bid item shall be full compensation, including overhead and profit, labor, materials, equipment, construction, operational start-up, temporary dewatering facilities, and any and all other items needed to for a complete and operational Mechanical Dewatering system in accordance with these Contract Documents unless specifically included in a subsequent Bid Item.

Payment shall be on a Lump Sum basis.

Bid Item (B2) Schedule B Electrical:

This Lump Sum bid item shall be full compensation, including overhead and profit, labor, materials, equipment, installation, controls, construction, operational start-up, and all other items needed for a complete and operational electrical system for the Mechanical Dewatering Improvements in accordance with these Contract Documents.

Payment shall be on a Lump Sum basis.

Schedule C: Clarifier Improvements:

Bid Item (C1) Clarifier Improvements:

This Lump Sum bid item is for all Work not specifically included in Bid Items C2 and which is required to complete the Clarifier Improvements as shown on the Drawings and indicated in the specifications (including demolition). See Section 01 01 00 Paragraph 2.00 C. for description of Schedule C work. This bid item shall be full compensation, including overhead and profit, labor, materials, equipment, construction, operational start-up, temporary facilities, and any and all other items needed to for complete and operational Clarifier systems in accordance with these Contract Documents unless specifically included in a subsequent Bid Item.

Payment shall be on a Lump Sum basis.

Bid Item (C2) Schedule C Electrical:

This Lump Sum bid item shall be full compensation, including overhead and profit, labor, materials, equipment, installation, controls, construction, operational start-up, and all other items needed for a complete and operational electrical system for the Clarifier Improvements in accordance with these Contract Documents.

Payment shall be on a Lump Sum basis.

****END OF SECTION****

1.00 GENERAL

1.01 SPECIFICATION STRUCTURE:

A. Format

These specifications are organized in the format promulgated by the Construction Specification Institute (CSI Format). This format assigns permanent numbers to all Divisions and Sections and, so far as possible, assigns all products, processes, activities and construction requirements permanent places in the specifications. A number is assigned that, generally, will not change from project to project. Division, Section and Subsection numbers that are not required are omitted from the Specifications. **Special provisions, requirements and/or revisions to the Specifications may be included in the Supplemental Conditions, Section 01 01 00 (green pages) or on the Drawings or Details.**

B. Index

All sections required for a complete contract appear in the Index. Bidders and Contractors should check sections present against the Index to ensure the presence of all required sections of the contract.

C. Work

No attempt has been made in these Specifications or Plans to segregate work covered by any trade or subcontractor under one specification. Such segregation and establishment of subcontract limits shall be solely a matter of specific agreement between the Contractor and his subcontractors and shall not be based upon an inclusion, segregation or arrangement in or of these specifications. The Contractor and Subcontractor in each case is warned that work included in any subcontract may be divided among several specifications and that any specification or portion thereof may include work covered by more than one subcontract.

1.02 COORDINATION REQUIRED:

The Contractor shall provide adequate notice to the Owner and/or Engineer regarding times when shutting down existing utilities is required. The Contractor shall use extreme care when working across, under, or near existing water and sewer utilities of the Owner. The Contractor is responsible for any damage to existing utilities and appurtenances.

1.03 WEEKLY CONSTRUCTION MEETINGS:

Weekly construction meetings involving the Contractor's on-site superintendent, a representative of the Engineer, the Owner, and others, as necessary, may be held on-site at a day and time agreed upon by the parties.

1.04 CONSTRUCTION STAKING:

A. The Contractor is responsible for all horizontal and vertical construction staking required to complete the work including, but not limited to, setting and maintaining all alignment stakes, slope stakes and grades necessary for construction. Except for the survey control data to be furnished by the Owner, calculations, surveying, and measuring required for setting and maintaining the necessary lines and

grades shall be the Contractor's responsibility. The Contractor shall provide the Engineer copies of calculations and staking data if requested by the Engineer.

- B. The Contractor shall be responsible to provide preconstruction surveying and documentation of existing roadways as required to properly re-establish street sections.
- C. All survey work shall be done by a surveyor registered to practice in the State of Washington. Unless a separate bid item is provided, all survey work shall be considered incidental to the other work and a separate payment will not be made.
- D. The Owner will provide benchmark elevations for vertical control and coordinates of horizontal control points. Stake marks and other reference points, including existing monumentation, set by the Owner shall be carefully preserved by the Contractor. The Contractor will be charged for the costs of replacing stakes and monumentation that were not to be disturbed, but were destroyed or damaged by the Contractor's operation. This charge will be deducted from monies due, or to become due, to the Contractor. The Contractor shall preserve permanent survey markers.
- E. The Contractor shall, in accordance with RCW 58.09 and WAC 332-120, document and replace all monuments that are disturbed during construction. See paragraph 1.13 of this section.
- F. The Contractor shall provide surveying accuracy within the following tolerances:

Description	Vertical	Horizontal
Slope Stakes	0.10 feet	0.10 feet
Subgrade stakes	0 feet high 0.04 feet low	0.25 feet (parallel to alignment) 0.1 feet (normal to alignment)
Stationing on Roadway	N/A	0.1 feet

Description	Vertical	Horizontal
Alignment on Roadway	N/A	0.04 feet
Surfacing Grade Stakes	0.01 feet	0.25 feet (parallel to alignment) 0.1 feet (normal to alignment)
Roadway Paving Pins for Surfacing	0.01 feet	0.25 feet (parallel to alignment) 0.1 feet (normal to alignment)

- G. The survey work shall include but not be limited to the following:
 1. Verify the primary horizontal and vertical controls furnished by the Owner and expand into secondary control by adding stakes and hubs, as well as additional survey control needed for the project. Provide description of secondary control to the Owner.
 2. Establish the centerlines of all alignments by placing hubs, stakes or marks on centerline, or on offsets to centerline, at all curve points (PCs, PTs, and PIs), at all intersections, and at points on the alignments spaced no further than 50 feet.
 3. Establish clearing limits, placing stakes at all angle points and intermediate points not more than 50 feet apart.

4. Establish grading limits, placing stakes at all angle points and at intermediate points not more than 50 feet apart.
 5. Establish the horizontal and vertical location of all site features, including basins, structures, piping and site appurtenances.
 6. Establish intermediate elevation benchmarks as needed to check the work throughout the project.
 7. Establish roadbed and surfacing elevation by placing stakes/hubs at the top of subgrade and at the top of each course of surfacing. Subgrade and surfacing stakes/hubs shall be set at horizontal intervals not greater than 50 feet in tangent section, 25 feet in curve sections with a radius less than 300 feet, and at 10 foot intervals in intersection radii with a radius less than 10 feet. Provide for paving pins at 25 foot intervals, or provide simultaneous surveying to establish location and elevation of paving pins as they are being placed.
 8. Driveway Staking: The Contractor is responsible to stake the location and elevations of all driveway entries.
 9. Curb and Sidewalk Staking: When curb and sidewalk are contiguous, one set of stakes will be required. Stationing will be at 25 foot intervals with offset to face of curb and cut/fill to top of curb. When sidewalks are separated by more than 10 feet, an additional line will be set for sidewalk at 50 foot intervals.
 10. Setting and maintaining 2-inch by 2-inch offset hubs with a tack at 50-foot intervals for sewer pipe line and grade. The offset hub shall be set perpendicular to the pipe line, with two hubs set at manholes. The stationing, offset distance, cut to invert, and hub elevation shall be marked on the guard stake. A copy of cut sheets with reference to actual benchmark elevations shall be provided to the Engineer at the same time it is supplied to the Contractor, but not less than two (2) working days prior to construction.
 11. Construction staking for water mains shall be as required to install the water mains on the alignments and at the depths as shown and specified on the Drawings.
 12. Setting and maintaining 2-inch by 2-inch offset hubs at all sewer and water service connections. The stationing, cut to invert, and hub elevation shall be marked on the guard stake. Side sewer stubs and water services shall be staked before proceeding with the construction of an affected sewer or water main. For each side sewer stub, two laths shall be set: one at the stub end and one at the offset hub. The Contractor shall set an adequate number of construction stakes to ensure that all project elements are installed as shown.
 13. For all other types of construction included in this project, provide staking and layout as necessary to adequately locate, construct, and check the specific construction activity.
- H. Alternative methods differing from those described above may be proposed by the Contractor. In any case, the Contractor shall be solely responsible for providing adequate surveying and staking to insure that the work is installed as shown on the Drawings and as specified.

1.05 RECORD DRAWINGS:

The Contractor shall maintain on site a set of plans for the sole and specific purpose of accurately and promptly recording all changes and modifications in the work as it proceeds. The location, depth, and description of all existing utilities, structures and improvements encountered in the work shall also be accurately recorded. Monthly and final payments may be withheld until record drawing information is brought up to date. Final payment will not be released until the Contractor's record drawings are submitted to the Engineer and accepted.

1.06 CONSTRUCTION WATER:

The Contractor will be responsible for obtaining, transporting, and applying such water as is required for proper construction in accordance with the Plans and Specifications. Water will be supplied by the Owner at appropriate fire hydrants at no charge to the Contractor.

1.07 CONTRACTOR SITE INVESTIGATION:

- A. By submitting a Bid Proposal for this work, the Contractor acknowledges that he has satisfied himself as to the nature and location of the work and the general and site-specific conditions, particularly those bearing upon the availability of transportation, disposal, handling and storage of materials, the availability of labor, water, electric power, access, equipment and material deliveries, uncertainties of weather, river stages or other physical conditions at the site, the conformation and conditions of the ground including the potential for the existence of rock and/or groundwater, the character of such equipment and materials needed to prosecute the work, and all other matters of any nature which may affect the work under this Contract or the cost thereof.
- B. The Contractor warrants that, as a result of his site investigation and examination of the above data, he can and will perform the work in accordance with the Contract Documents and good construction practice. The Owner assumes no responsibility for any representations made by any of its officers or agents prior to or during the work.

1.08 EXISTING UTILITIES LOCATION AND PROTECTION: (See also General Conditions)

- A. The descriptions and locations of known existing utilities shown on the Drawings are approximations only and may not be sufficiently accurate to plan construction operations. Other utilities may exist in the work areas that are not shown on the Drawings. Information on known existing utilities and structures shown on the Drawings is provided for the convenience of the Contractor only, and no responsibility is assumed for its accuracy or completeness.
- B. At locations where the Contractor's operations could result in damage, disruption, loss, expense or inconvenience of railway, telephone, telegraph, power, oil, gas, water, sewer, irrigation, cable service, or other private or municipal systems, the operations shall be suspended until adequate arrangements and coordination necessary for the protection thereof have been made by the Contractor.
- C. Prior to start of work and to construction staking, the Contractor shall contact all utility owners to field locate and mark such utilities. It shall be the Contractor's responsibility to preserve and protect utility field location markings and to record such locations on the Record Drawings. Under no circumstances is the Contractor to expose any underground utility before obtaining permission to do so from the utility owner.

1.09 EXISTING STRUCTURES AND IMPROVEMENTS:

- A. The Contractor shall take necessary precautions to prevent damage or disturbance to existing structures and improvements, whether above or below ground. Structures and improvements shown on the Drawings are intended as a general guide only; other structures and improvements may exist that are not shown.
- B. Where existing structures or improvements including, but not necessarily limited to, buildings, fences, shrubs, trees, lawns, landscaping, crops, drives, walks, pavement, or other surfaces are disturbed or damaged as a result of the Contractor's operations, the Contractor shall restore, repair or replace such structures or improvements to their original condition to the satisfaction of the Owner, Engineer, and affected property owner. The Contractor shall notify the Engineer immediately of any such damage or disruption and make repairs promptly, as and when approved by the Engineer. Unless the Contract Documents specify otherwise, all responsibility for protection, repairs, claims or expenses resulting from the Contractor's operations affecting existing structures and improvements shall be solely the Contractor's and no additional payment will be made therefore.
- C. If existing structures and/or improvements are encountered that will prevent further construction and which are not properly shown on the Drawings, the Contractor shall notify the Engineer immediately before continuing construction in order that the Engineer may evaluate the possibility of making field revisions to the work to avoid or minimize conflict with such existing structures or improvements. If the Contractor fails to make such notification and proceeds with construction despite the interference, he shall do so entirely at his own risk and expense.
- D. The Contractor shall provide temporary drainage methods and/or protection when his operations in any way disrupt or interfere with existing drainage facilities or patterns. The adequacy and timeliness of such temporary drainage methods and/or protection shall be the sole responsibility of the Contractor, as shall the liability for claims and/or expenses resulting from its inadequacy.

1.10 LIMITS OF WORK:

Unless indicated otherwise on the Drawings or in these Specifications, the Contractor shall limit all operations, including material storage and project access, to the easements and/or rights-of-way indicated on the Drawings or described in the Specifications, except as permitted by other property owners in separate agreements with the Contractor.

1.11 EXISTING MONUMENTS AND SURVEY MARKERS:

The Contractor shall preserve, protect and/or replace all existing federal, state, county, municipal or private land monuments and survey markers in the work area, including property corners. The Contractor shall comply with all state and federal laws pertaining to the disturbance, removal and replacement of survey monuments, points or markers. The Contractor shall provide the Engineer with sufficient documentation that an appropriate search has been conducted to identify any local survey markers that could be disturbed prior to the start of construction. This documentation shall include, but is not limited to, copies of letters or other forms of request for information from local surveyors or governmental agencies regarding the search for survey monuments, etc. If such monuments or markers are to be disturbed by the Contractor's operation, he shall complete such applications and referencing as required by law for the removal of survey monuments or markers. The Contractor shall provide the Engineer with a copy of the application sent to the appropriate government agency. The Contractor shall be responsible to replace such monuments and survey markers and complete the

permit process at his own expense, at no additional cost to the Owner. The Contractor shall provide the Engineer with a copy of the completed permit he has returned to the appropriate government agency once the monuments and survey markers are replaced.

1.12 TEMPORARY CONSTRUCTION UTILITIES AND FACILITIES:

The Contractor shall make arrangements for temporary electrical power, telephone, and sanitary facilities as may be required for the work and/or by federal, state, or local regulations. Unless specifically indicated otherwise in the Drawings or Specifications, all costs for such utilities and facilities shall be borne by the Contractor and no additional payment will be made therefore. All temporary utilities and sanitary facilities shall comply with applicable codes and safety, health, and other agency regulations as applicable.

1.13 ACCIDENT REPORTS

In the event of any accident, injury, or damage as a result of the work of this Contract or at or near the project site, the Contractor shall immediately notify the Owner and Engineer by telephone, messenger, or in person. The Contractor shall promptly follow up such verbal notification with a written report of the occurrence to the Owner and Engineer, giving full details and statements of witnesses. If a claim is made by anyone against the Contractor or any Subcontractor as a result of such an occurrence, the Contractor shall promptly report the facts in writing to the Owner and Engineer, including full details of the claim.

1.14 SAFETY:

- A. The Contractor shall develop and maintain for the duration of this project a safety program that will effectively incorporate and implement all federal, state and local safety requirements. The Contractor shall appoint a qualified employee to supervise and enforce such a program.
- B. The activities of the Owner and Engineer in conducting reviews and inspections of the materials, performance, and installed work of the Contractor is not intended to constitute review and approval of the adequacy of the Contractor's safety supervisor, program, or practices in, on, or near the construction site.
- C. The Contractor shall maintain at his field shop or office all such safety equipment and supplies as required for the work and by regulations, including emergency and first aid supplies.
- D. The Contractor shall do all work necessary to protect the public and project persons from hazards, including, but not limited to, surface irregularities in sidewalks, paths, driveways and roads, excavations, slippery surfaces, electrical conductors and equipment, tools, and construction vehicles or equipment. Barricades, fencing, lights, and signs shall be installed and maintained to adequately provide such protection in accordance with regulations and as required by the Owner.
- E. All work and all completed construction shall be in accordance with applicable governing regulations and authorities, especially in regards to excavations, ladders, platforms, structure openings, scaffolding, lagging, machinery guards, and electrical items.
- F. Safe access shall be provided at all times for local, state, or federal authorities and inspectors, as well as for the Owner and Engineer.

1.15 TRAFFIC MAINTENANCE, CONTROL AND SAFETY:

- A. The Contractor shall be solely responsible for traffic maintenance, control, and safety and shall comply with all ordinances and regulations of the applicable federal, state, and/or local authorities regarding the closing, restricting, crossing, and detouring upon or working within public roads, streets and highways. No public or private road or driveway shall be closed, except by express permission of the governing authority or property owner as applicable. All work shall be planned and conducted in such a fashion as to minimize disruption of traffic and access to adjacent public, private, or commercial properties.
- B. The convenience of the general public and the protection of persons and property shall be the primary consideration and adequate planning, arrangements, and scheduling shall be the Contractor's responsibility to ensure such convenience and protection.
- C. The Contractor shall, at his own expense (unless a specific bid item is provided), provide flagging and maintain suitable bridges, detours, traffic control and other temporary items for accommodation of traffic. The Contractor shall obtain Owner approval of all road closures and detour routes. The Contractor shall be solely responsible for notifying such authority or property owners prior to performing any operations that may affect public or private rights-of-way.
- D. Where traffic will pass over trenches before they are resurfaced, they shall be maintained in a firm and smooth condition that will allow normal vehicular traffic. Temporary access driveways shall be provided where required. Clean-up shall be accomplished immediately after backfill and the site shall be kept free of debris and material at all times.
- E. Access for fire fighting equipment shall be provided at all times and the Contractor shall keep the local fire protection authorities informed at all times of the location of construction operations and fire lanes.
- F. The Contractor shall also notify the authorities in charge of any municipal, private, or school transportation systems at least 48 hours in advance of road closures or detours that will force a change in the regular routing of the transportation system.
- G. Other specific requirements regarding temporary surfaces, access, site conditions, and traffic control may be included in other sections of these Specifications.

1.16 SITE RESTORATION AND CLEAN-UP:

All areas affected by the Contractor's operations shall be kept neat and reasonably free of debris and waste materials. Upon completion of the work in any particular area, the Contractor shall return all surfaces to their original or better condition and remove all excess materials and debris. All areas shall be graded smooth to blend with abutting undisturbed areas and with drainage characteristics similar to prior to disturbance. All existing drainage ditches and culverts shall be carefully and fully restored to their original condition and function, or better, promptly after work in the area is sufficiently completed.

1.17 DUST PREVENTION:

The Contractor shall take whatever measures are necessary to prevent dust in the work areas, including periodic application of water or dust preventative material. Environmental regulations regarding dust prevention shall be adhered to.

1.18 POLLUTION CONTROL:

The Contractor shall be responsible for the prevention of pollution (including that caused by silt or other run-off) of surrounding land, waterways, groundwater, or ecosystems. Should the Contractor deem it necessary to dispose of any pollutant, as defined by the U.S. Environmental Protection Agency and/or Washington State Department of Ecology, he shall obtain the written authorization of the Owner, Engineer, and local, county, state, and federal regulating agencies regarding such matters at his own expense.

1.19 LABOR STANDARDS AND EQUAL OPPORTUNITY REQUIREMENTS:

The Contractor's attention is directed to applicable Contract requirements regarding labor standards, equal opportunity, affirmative action, and related federal and state requirements. These requirements are an integral part of this Contract. Failure to comply with these requirements, including timely submission of reports and documentation, may result in delay of Contract payments, in addition to other remedies available to the Owner.

1.20 THIRD-PARTY BENEFICIARY CLAUSE (IF REQUIRED BY FUNDING AGENCY):

All parties agree that the State of Washington shall be, and is hereby named, as an express third-party beneficiary of this contract and any subsequent contracts or subcontracts with full rights as such. This clause shall also be included in all contracts between the Contractor and subcontractors.

1.21 ACCESS TO RECORDS AND TO CONSTRUCTION SITE BY DEPARTMENT OF ECOLOGY PERSONNEL: (WADOE funded projects only)

The Contractor shall provide for the safe access to the construction site and to the Contractor's records by the State of Washington Department of Ecology personnel.

1.22 ARCHAEOLOGICAL DISCOVERIES AND HISTORIC PRESERVATION:

A. The Contractor shall adhere to the National Historic Preservation Act of 1966 and 36 CFR 800, which provides for the preservation of potential historical architectural, archaeological, or cultural resources (hereinafter called "cultural resources") and fair compensation to the Contractor for delays resulting from such cultural resources investigations.

B. In the event that potential cultural resources are discovered during subsurface excavations at the site of construction, the following procedures shall be instituted:

1. The Owner shall issue a Work Suspension Order directing the Contractor to cease all construction operations at the location of such potential cultural resources find.
2. If archaeological findings include human remains, the Engineer shall contact a qualified archaeologist, in consultation with the State Historic Preservation Officer (SHPO), to evaluate the remains.

3. Such Work Suspension Order shall be effective until such time as a qualified archaeologist can be contacted by the Engineer to assess the significance of these potential cultural resources and make recommendations to the State Historical Preservation Officer. If the archaeologist, in consultation with State Historic Preservation, determines that the potential find is a significant cultural resource, the Owner shall extend the duration of the Work Suspension Order.
4. Suspension of work at the location of the find shall not be grounds for any claim by the Contractor, unless the suspension extends beyond the contract working days allowed for the project, in which case the Engineer will make an adjustment for increased cost of performance of the contract.

1.23 CONTRACTOR WORK HOURS:

Except as may be otherwise specified in Section 01 01 00 (or as may be further restricted by local ordinance), and except in connection with the safety and protection of persons, property, or the work, no work shall be done between the hours of 5:30 p.m. and 7:00 a.m., nor on Saturdays, Sundays, or legal holidays, without the Owner's written consent given after the Contractor's prior written request submitted to the Engineer.

1.24 ABANDONMENT OF EXISTING PIPE:

Abandonment of 3" and larger water, sewer, drain, or other buried pipe shall mean plugging with concrete all pipe where cut or broken open (including, but not necessarily limited to, open pipe ends exposed during construction) or removal of the pipe from the ground. All concrete plugs shall fully seal the opening, shall extend at least 1 ft. into the pipe from the opening, and shall effectively prevent future subsidence of soil above the pipe opening.

****END OF SECTION****

1.00 GENERAL

1.01 GENERAL:

- A. This Section covers requirements and methods for the Measurement and Payment of work for the project.
- B. Special provisions, requirements, and/or revisions to this Specification and/or Bid Item(s) may be included in Section 01 01 00 (green pages) and/or on the Drawings or Details.

1.02 LOCATION OF DESCRIPTION:

- A. Standard bid item descriptions are found in subsection 4.0 - Measurement and Payment, of each Section of the Technical Specifications.
- B. Non-standard bid item descriptions are found in Section 01 01 00 - Special Requirements/Bid Items.

1.03 BID PRICES:

The prices bid for any and all items of work shall cover the cost of furnishing all labor, materials, equipment, tools, supervision, and any other incidental costs required to provide complete and satisfactorily operational system(s) in accordance with these Contract Documents.

1.04 WORK NOT SPECIFICALLY MENTIONED:

- A. Any item of work shown on the Drawings or required by the Specifications for which no bid item is provided, shall be considered incidental and included in other Bid Items, and no additional payment will be made therefore.
- B. Any work, materials, or equipment not specifically mentioned as included in an item of work, but which is (are) required for its proper execution, shall be considered as included in the price bid for the item and no additional payment will be made to the Contractor for such work.

1.05 ESTIMATED QUANTITIES:

The estimated quantities shown in the bid forms are estimates only, being given only as the basis for the comparison of bids, and the Owner does not warrant, expressly or by implication, that the actual amount of work will correspond therewith. The right to increase or decrease the amount of any class or portion of the work, to delete items of work, or to make changes in the work required, as may be deemed necessary, is reserved by the Owner as provided elsewhere in these Specifications. The basis of payment will be the actual unit bid items of work performed and measured in accordance with the Contract. All prospective bidders should note that certain bid items may be included in the Contract Proposal to establish a unit price should the use of those items become necessary during construction. Allowance will not be made for loss of anticipated profits or additional compensation should the use of these items be deemed unnecessary.

1.06 MEASUREMENT OF PAY QUANTITIES:

The Engineer shall make all measurements and determine all quantities and amounts of work done under

the Contract. At the time measurements are made for quantity determinations, the Contractor, or his authorized assistant, shall be present to verify such measurements. From quantity figures so ascertained, it will be the Contractor's responsibility to prepare a monthly periodical estimate of the work accomplished to date.

A. Description of Tally Method for Payment Quantities:

1. When Items are specified to be paid for by the cubic yard, ton, or truck count, the following tally system will be used:
 - a. All trucks to be employed on this work shall be measured by the Engineer to determine the capacity of each truck.
 - b. Each truck shall be clearly numbered with no duplication of numbers.
 - c. Duplicate tally tickets shall be prepared to accompany each truckload of material delivered on the project. The tickets shall bear at least the following information:
 - i. Truck number;
 - ii. Quantity delivered in cubic yards or tons as applicable;
 - iii. Driver's name;
 - iv. Date and time;
 - v. Location of delivery; by street and stationing on each street;
 - vi. Place for receipting by the inspector.
 - d. It will be the Contractor's responsibility to see that an individual ticket is given to the inspector on the project for each truckload of material delivered. Pay quantities will be prepared on a basis of said tally tickets.
2. When the bid item stipulates quantities by weight, they shall be weighed on scales that are in accordance with the requirements of the State Highway Department for similar use. Certified weight bills shall be furnished.

1.07 PARTIAL PAYMENT REQUESTS:

A. See General Conditions

B. All requests for partial payment must be accompanied by a tabulation indicating the location of quantities for which payment is requested, and must include a certificate signed by the Contractor stating that all items for which payment is requested have been completed and tested in accordance with the Contract Documents. The Contractor shall use forms provided by the Engineer.

C. Prior to release of any payment where Federal Labor Standards and Davis-Bacon wage rates apply, the Contractor shall submit to the Engineer or Owner:

1. Contractor and Subcontractor certificates from Contractor Appointing Officer or Employee to Supervise Payment of Employees.

2. Contractor and Subcontractor certified weekly payrolls.
 3. Contractor and Subcontractor Monthly Employment Utilization Reports.
- D. Weekly payroll reports shall be submitted on Form WH-347 or approved equivalent, in accordance with the Federal Labor Standards Provisions, if applicable. If a payroll report is submitted in any form other than on Form WH-347, it must be accompanied by Form WH-349, Statement of Compliance. Failure to submit the required weekly reports shall be sufficient cause to withhold any or all payments until the requirement is satisfied.
- E. Monthly Employment Utilization reports shall be submitted on Standard Form 257, if required by the project funding agencies. This monthly report shall be submitted to the Engineer or Owner each calendar month that work is performed on this Contract. Failure to submit the required monthly report shall be sufficient cause to withhold any or all payments until the requirement is satisfied.

1.08 RELEASE OF RETAINAGE:

Prior to the release of retainage, the Owner shall have received:

1. Identification from the Washington State Department of Revenue that sales tax has been paid by the Contractor. Verification from the Washington State Department of Labor and Industries that all worker's compensation and medical insurances have been paid.
2. Requirements outlined in the General Conditions are satisfied.

****END OF SECTION****

1.00 GENERAL

- A. The successful bidder shall submit to the Engineer a written list of all subcontractors that will work on the project prior to award of the contract and as soon as possible after bid opening.
- B. Special provisions, requirements, and/or revisions to this Specification and/or Bid Item(s) may be included in Section 01 01 00 (green pages) and/or on the Drawings or Details.

2.00 INFORMATION REQUIRED

- A. Name, address, and telephone number of Subcontractor.
- B. Identify type of work to be subcontracted and the percentage of the total contract that the work represents.
- C. List at least three (3) recently completed projects on which the Subcontractor performed work as specified in these Contract Documents with the following information:
 - 1. Name of project.
 - 2. Name, address, and telephone number of project owner.
- D. Any additional information to establish experience in performing the work specified, i.e., experience with the particular application, installation procedure, or equipment.

3.00 APPROVAL OF SUBCONTRACTOR

- A. The Owner will approve all subcontractors to be used by the Contractor, and no subcontractors will be allowed to perform work on the project without approval by the Owner.
- B. Should conditions make it impossible for the approved Subcontractor to perform the work, the Contractor shall submit to the Engineer the required information (see 2.00, INFORMATION REQUIRED) for an alternate subcontractor at least ten (10) days prior to the time scheduled for the subcontractor to begin his work.
- C. Approval of a Subcontractor by the Owner shall not relieve the Contractor or Subcontractor of the responsibilities specified or required by these Contract Documents, and any delays caused by failure of the Contractor to pre-qualify a Subcontractor will not be considered to be justification for extension of the "Time for Completion" of the project.

****END OF SECTION****

1.00 GENERAL

1.01 GENERAL

- A. This Section defines the process whereby the Schedule of Values (lump sum price breakdown) shall be developed and incorporated into the cost loading function of the Schedule as specified in Section 01 32 00. Monthly progress payment amounts shall be determined from the monthly progress updates of the Schedule activities.

The Schedule of Values shall be developed independently but simultaneously with the development of the Construction Schedule activities and logic as follows.

- B. Schedule of Values shall reflect approved substitute equipment proposed under the provisions of Section 01 32 00, with appropriate reference to the substitution.

1.02 PRELIMINARY SCHEDULE OF VALUES

- A. The CONTRACTOR shall submit a preliminary Schedule of Values for the major components of the WORK in accordance with Section 01 33 00. Preliminary Schedule of Values shall be submitted within 14 days of Notice To Proceed. The primary Schedule of Values listing shall be consistent with the bid schedule. Schedule of Values shall include, at a minimum, the proposed value for the following major WORK components:

1. Mobilization and Demobilization (see Section 00 13 00): Not to exceed 10% percent of Total Contract Price. Payable not to exceed 50% of the item amount in the initial progress payments following complete on-site installation of Contractor and Owner/Engineer construction trailers and appurtenances (see Section 01 52 13), submittal of all initial submittal items (Schedule of Values, Construction Schedule, Bond and Insurance Certificates, etc.). Additional 30% of Mobilization and Demobilization budget item shall be payable progressively during construction, proportional to percentage of work completion on remaining bid items. Final 20% of Mobilization and Demobilization item bid shall be payable following satisfactory cleanup of site and removal of all temporary facilities (see Section 01 77 00 and WSDOT 1-04.11).
2. Spill Prevention, Control, and Containment: All costs of preparation and compliance with Spill Prevention, Control, and Containment requirements.
3. Trench Excavation Safety Provisions: Does not need to be broken down for Schedule of Values. Payable upon receipt of confirmation that trench safety plan is in place and being enforced. Trench safety plan shall be incorporated into Accident Prevention Plan or attached thereto.
4. Work Items: As a minimum each of the work items, except as excluded herein, shall be broken down according to Specification Division.
5. Site Civil Improvements shall be broken down according to specific discipline (i.e., asphalt paving, final site grading, sidewalks, etc.).
6. Process and Site Piping shall be broken down according to pipe system, and each system shall have major components (i.e., SL pipe from Digester to Dewatering) independently listed.

7. Electrical shall be broken down: first by construction area (overall site, pump station, headworks, etc.), then by major pieces of electrical equipment, process power wiring, process control wiring, lighting fixtures, lighting installation and wiring, receptacle installation and wiring.
8. Instrumentation and Control shall be broken down by individual control panel identifications, installation by building or site area, yard work, PLC software, SCADA software, training, testing, startup.
9. Work items containing major equipment items (individual equipment items costing \$10,000 or more) shall break out each such item separately.
10. Items approved under the provisions of Section 01 25 00 shall be individually broken out. Reference to the equipment and the Base Bid equipment replaced shall be included.
11. The CONTRACTOR and ENGINEER shall meet and jointly review the preliminary Schedule of Values within one week following receipt of the submittal by the ENGINEER, and make any adjustments in value allocations if in the opinion of the ENGINEER, these are necessary to establish fair and reasonable allocation values for the major WORK components. Front end loading will not be permitted. The ENGINEER may require reallocation of major WORK components from items in the above listing if in the opinion of the ENGINEER such reallocation is necessary. This review and any necessary revisions shall be completed within 21 days from the date of Notice to Proceed.

1.03 DETAILED SCHEDULE OF VALUES

A. The CONTRACTOR shall prepare and submit a detailed Schedule of Values to the ENGINEER within 30 days from the date of Notice to Proceed. The detailed Schedule of Values shall be based on the accepted preliminary Schedule of Values for major WORK components. Primary Schedule of Values items shall be consistent with the Bid Schedule. Because the ultimate requirement is to develop a detailed Schedule of Values sufficient to determine appropriate monthly progress payment amounts through cost loading of the Schedule activities, and to assist the OWNER in allocation of costs among potentially various funding sources, sufficient detailed breakdown shall be provided to meet this requirement. The ENGINEER shall be the sole judge of acceptable numbers, details, and description of values established. If, in the opinion of the ENGINEER, a greater number of Schedule of Values items than proposed by the CONTRACTOR are necessary, the CONTRACTOR shall add the additional items so identified by the ENGINEER.

1. The minimum detail of breakdown of the major WORK components is indicated in Paragraph 1.02, above. Additional information is presented below to refine the Schedule of Values to allow use for development of monthly progress payments. Greater detail shall be provided as directed by the ENGINEER.
 - a. Mobilization – breakout cost of bonds, insurance, permits, contractor office and shop setup, engineer and owner office and facilities setup, and other up-front costs, allocation for progress payments, and allocation for close-out.
 - b. The electrical WORK shall be broken down by in-plant structure yard facilities, remote sites. Electrical work for structures shall be broken down into process power

SCHEDULE OF VALUES

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conduit, process control conduit, process power wire, process control wire, total and unit costs for each lighting fixture, both fixture cost, and installation costs, receptacle power and installation, individual transformer cost, main switchboard cost, main switchboard installation cost, engine generator installation costs, each motor control center installation costs, training costs, testing costs. Yard facilities shall be broken down by duct bank designations.

- c. Instrumentation and Control WORK shall be broken down by structure and process area, individual PCM, graphic panel, SCADA computer system, printers, SCADA software, PCM software, RTU hardware, RTU software, total and unit costs for each field instrument type, testing, training, O&M manuals, in addition to the requirements of Division 16.
- d. Protective Coating WORK shall be broken down by structure and yard area component (i.e., structure wall painting, equipment preparation and painting, etc.). Where specific coating WORK at structures or yard areas may be critical to performing the WORK to meet milestone and Contract dates, such WORK shall be included as individual pay and Schedule activity items.
- e. Yard piping WORK shall be broken down into individual pipelines running from and to Contract termination points. Each pipeline shall be an individual pay item unless otherwise allowed by the ENGINEER.
- f. Mechanical WORK shall be broken down within each structure to identify individual piping systems, equipment installation by equipment name and equipment testing and checkout, and an allocation of cost for providing approved EQUIPMENT MANUALS (not less than 5% of cost of equipment item).
- g. Each equipment item shall have a minimum of 5% of its cost allocated to an approved EQUIPMENT MANUAL in accordance with the General Conditions, and this Section.
- h. Concrete structures shall be broken down into excavation plan, submittal excavation, subgrade preparation, and appurtenant pre-foundation WORK, concrete foundation construction, slabs on grade, walls/columns, suspended slabs, stairs etc. (sufficient breakdown shall be provided to accommodate necessary Schedule detail), hydrostatic structure testing where required and backfill.
- i. Building architecture shall be broken down into building frame erection, roofs, decks, siding and soft WORK, insulation, doors/windows/louvers and any other items determined to be necessary for establishment of pay and Schedule activity items.
- j. HVAC shall be broken down by major mechanical components, ductwork, control, testing and balancing.
- k. Civil site WORK shall be broken down into individual drainage piping, drainage structures, site concrete, paving, excavation cut and fill removal of existing pipe, clearing and grubbing and any other items determined to be necessary for the establishment of Pay and Schedule Activity items.
- l. Equipment testing and plant startup broken down for completion milestones for each.

- m. All other WORK not specifically included in the above items shall be broken as down as necessary for establishment of pay and Schedule activity items.

The CONTRACTOR and ENGINEER shall meet and jointly review the detailed Schedule of Values within 14 days of its submittal, and not more that 60 days from the date of Notice to Proceed or at the Preconstruction Meeting. The value allocations and extent of detail shall be reviewed to determine any necessary adjustments to the values and to determine if sufficient detail has been proposed to provide cost loading of the Schedule activities. Any adjustments deemed necessary to the value allocation or level of detail shall be made by the CONTRACTOR and a revised detailed Schedule of Values shall be submitted within 10 days of the receipt of the Engineer review, and within 80 days from the date of Notice to Proceed.

- 2. Following acceptance of the detailed Schedule of Values, the CONTRACTOR shall incorporate the values into the cost-loading portion of the Schedule. The Schedule activities and logic shall have been developed concurrent with development of the detailed Schedule of Values; however, it shall be necessary to adjust the detailed Schedule of Values to correlate to individual Schedule activities. It is anticipated that instances will occur, due to the independent but simultaneous development of the Schedule of Values and the Schedule activities, where interfacing these two documents will require changes to each document. Schedule of Value items may need to be added to accommodate the detail of the Schedule activities. Where such instances arise, the CONTRACTOR shall propose changes to the Schedule of Values and to the Schedule activities to satisfy the Schedule cost loading requirements.

1.04 CROSS REFERENCE LISTING

- A. To assist in the correlation of the Schedule of Values and the Construction Schedule, the CONTRACTOR shall provide a Cross Reference Listing, which shall be furnished in two parts. The first part shall list each Scheduled Activity with the breakdown of the respective valued items making up the total cost of the activity. The second part shall list the valued item with the respective Scheduled Activity or Activities that make up the total cost indicated. In the case where a number of schedule items make up the total cost for a valued item (shown in the Schedule of Values) the total cost for each scheduled item should be indicated.
- B. These listings shall be updated and submitted in conjunction with the monthly Schedule submittals as stated in Specification Section 01 32 00.
- C. Approved change orders reflected in the Schedule shall be incorporated into the Schedule of Values as a single unit identified by the change order number.

1.05 CHANGES TO SCHEDULE OF VALUES

- A. Changes to the Schedule which add activities not included in the original schedule but included in the original WORK (schedule omissions) shall have values assigned as approved by the ENGINEER. Other activity values shall be reduced to provide equal value adjustment increases for added activities as approved by the ENGINEER.
- B. In the event that the CONTRACTOR and ENGINEER agree to make adjustments to the original Schedule of Values because of inequities discovered in the original accepted detailed Schedule of Values, increases and equal decreases to values for activities may be made.

- C. In the event that during development of the Schedule of Values, it becomes apparent that mis-allocations of costs were made during development of the Bid Schedule, the Bid Schedule may be revised, by No-Cost Change Order to provide accuracy and utility to the Schedule of Values.

1.06 **LIQUIDATED DAMAGES**

- A. The Schedule of Values information is an integral part of the scheduling and reporting under Section 01 32 00 and the progress payment information. As such, it is critical information to evaluating the project's progress and the proper planning of the OWNER'S and ENGINEER'S work effort as well as their financial obligations associated with this project. Accordingly, if any submittal required by this Section is found to be incomplete or is submitted later than required, the OWNER will suffer financial loss and, accordingly, the ENGINEER will not recommend CONTRACTOR'S Progress Payments until the submittals required by this section are completed and accepted by the ENGINEER.

2.00 PRODUCTS (Not Used)

3.00 EXECUTION (Not Used)

****END OF SECTION****

1.00 GENERAL

1.01 DESCRIPTION:

A. Mobilization and administration required for this work may include, but is not necessarily limited to, the following items and work associated with any or all of the various schedules of the work when required by the Contract Documents:

- | | |
|-------------------------------|---------------------------------|
| 1. Bonds and Insurance | 8. Submittals and Shop Drawings |
| 2. Mobilization | 9. Invoice Preparation |
| 3. Preconstruction Conference | 10. Administration |
| 4. Temporary Facilities | 11. Material Testing |
| 5. Project Sign | 12. Record Drawings |
| 6. Permits and Licenses | 13. Demobilization |
| 7. Construction Schedule | |

B. Special provisions, requirements and/or revisions to this Specification and/or Bid Item(s) may be included in Section 01 01 00 (green pages) and/or on the Drawings or Details.

2.00 PRODUCTS

2.01 GENERAL:

Products and materials required for mobilization and administration are described in the various sections of this Division 1 and other parts of the Contract Documents.

3.00 EXECUTION

3.01 GENERAL:

Execute the mobilization and administration as required by the various sections of this Division 1 and other parts of the Contract Documents.

4.00 MEASUREMENT AND PAYMENT

4.01 GENERAL:

See Section 01 22 00 - Measurement and Payment for General Requirements. See Section 01 01 00 - Special Requirements/Bid Items for possible modifications to Standard Bid Items.

4.02 BID ITEMS:

Special provisions, requirements, revisions to these Bid Items, and/or additional Bid Items, may be included in Section 01 01 00 (green pages) or on the Drawings or Details.

MOBILIZATION AND ADMINISTRATION

Section 01 30 00 - Page 2

A. Mobilization and Administration

Payment for mobilization and administration shall be made on a lump sum basis. The amount for this bid item is limited to eight percent (8%) of the total bid, unless shown as greater on the Bid Schedule.

****END OF SECTION****

1.00 GENERAL

1.01 GENERAL

- A. The scheduling of the WORK under the Contract shall be performed by the CONTRACTOR in accordance with the requirements of this Section. The development of the Construction Schedule, cost loading of the schedule, monthly payment requisitions, and project status requirements of the Contract shall employ a Critical Path Method (CPM) scheduling. A bar chart system delineating the project schedule with development of critical path, approved by the ENGINEER, will meet the requirements of this Section. The cost-loading schedule based on schedule of values as approved by the ENGINEER in accordance with Section 01 29 73, shall be provided with the schedule.

1.02 INITIAL SCHEDULE SUBMITTALS

- A. The CONTRACTOR shall submit, within 14 days after the commencement date stated in the Notice to Proceed, two short term schedule documents to the Engineer, which shall serve as the CONTRACTOR'S Plan of Operation for the initial 60 day period of the Contract Time and to identify the manner in which the CONTRACTOR intends to complete all work within the Contract Time. The CONTRACTOR shall submit (1) a 60 day Plan of Operation bar chart, and (2) a project overview bar chart type plan for all work as indicated below.
1. 60 Day Plan of Operation: During the initial 60 days of the Contract Time, the CONTRACTOR shall conduct Contract operations in accordance with the 60 day bar chart Plan of Operation. The bar chart so prepared and submitted shall show the accomplishment of the CONTRACTOR'S early activities (mobilization, permits, submittals, necessary for early material and equipment procurement, submittals necessary for long lead equipment procurement, initial site work and other submittals and activities required in the first 60 days).
 2. Project Overview Bar Chart: The overview bar chart shall indicate the major components of the project work and the sequence relations between major components and subdivisions of major components. The overview bar chart shall indicate the relationships and time frames in which the various components of the WORK will be made substantially complete and placed into service in order to meet the project milestones as indicated on schedule. Sufficient detail shall be included for the identification of subdivisions of major components into such activities as (1) excavation, (2) foundation subgrade preparation, (3) foundation concrete, (4) completion of all structural concrete, (5) major mechanical work, (6) major electrical work, (7) instrumentation and control work, (8) installation of Equipment, (9) startup and testing, and (10) other important work for each major facility within the overall project scope. Planned durations and start dates shall be indicated for each work item subdivision. Each major component and subdivision component shall be accurately plotted on time scale sheets not to exceed 36-inch by 60-inch in size. The CONTRACTOR'S attention is directed to the requirement that the schedule shall contain sufficient detail and information to cost load the schedule in accordance with the approved schedule of values as specified under Section 01 29 73. Each installation and site work activity shall have been cost loaded as specified.

The ENGINEER will review 60-day plan of operations and project overview bar chart within 10 days after they have been submitted to the ENGINEER. The ENGINEER'S review and comment on the schedules shall be limited to Contract conformance. The CONTRACTOR shall make corrections to the schedules necessary to comply with the Contract requirements and shall adjust the schedules to incorporate any missing information requested by the ENGINEER.

1.03 FINAL SCHEDULE SUBMITTAL

A. Final Submittal

1. **Schedule:** The CONTRACTOR shall, within 30 days from the commencement date stated in the Notice to Proceed, submit a draft Final Schedule.
2. **Reports:** The final detailed CPM schedule shall include the following reports:
 - a. Three sorts of the standard CPM report, including as a minimum, activity numbers, descriptions, early and late start and finish dates, and total float; the required sorts shall be 1) by activity number, and 2) by total float; critical to most float.
 - b. Predecessor/successor report for each activity.
 - c. Narrative that explains the basis for the Contractor's determination of construction logic and estimated durations.

B. Final Schedule Review Meeting

Following submittal of the draft Final Schedule, within 10 days the CONTRACTOR shall meet with the ENGINEER to review the Final Schedule submittal. The CONTRACTOR shall have the Project Manager and Project Superintendent in attendance. The purpose(s) of the Schedule Review Meeting shall include:

1. Clarifications of the design intent, process, and startup requirements.
2. Directions to include activities and information missing from the submittal.
3. Requests to the CONTRACTOR to clarify the schedule.

C. Revisions to the Final Schedule

Within 10 days after the meeting between CONTRACTOR and ENGINEER, the CONTRACTOR shall have revised the original Final Schedule submittal to address all review comments from the original schedule review meeting and resubmit the schedule for the ENGINEER'S review. The ENGINEER, within 14 days from the date that the CONTRACTOR submitted his revised schedule will either (1) accept the schedule and cost loaded activities as submitted, or (2) advise the CONTRACTOR in writing to review any part or parts of the schedule which either do not meet the Contract requirements or are unsatisfactory for the ENGINEER to monitor the project's progress and status or evaluate monthly payment requests by the CONTRACTOR. The ENGINEER may accept the schedule with conditions that the first monthly schedule update be revised to correct deficiencies identified. When the schedule is accepted, it shall be considered as the "Final Construction Schedule" until an updated schedule has been submitted. The OWNER reserves the right to require that the CONTRACTOR adjust, add to, or clarify any portion of the schedule which may later be discovered to be insufficient for the monitoring of the

WORK or approval of partial payment requests. No additional compensation will be provided for such adjustments, additions, or clarifications.

D. Acceptance

The acceptance of the CONTRACTOR'S schedule by the ENGINEER and OWNER will be based solely upon the schedule's compliance with the Contract requirements. By way of the CONTRACTOR assigning activity durations and proposing the sequence of the WORK, the CONTRACTOR agrees to utilize sufficient and necessary management and other resources to perform the work in accordance with the schedule. Upon submittal of a schedule update, the updated schedule shall be considered the "current" project schedule.

Submission of the CONTRACTOR'S progress schedule to the OWNER or ENGINEER shall not relieve the CONTRACTOR of total responsibility for scheduling, sequencing, and pursuing the WORK to comply with the requirements of the Contract Documents, including adverse effects such as delays resulting from ill-timed work.

E. Monthly Updates and Periodic Schedule Submittals

Following the acceptance of the CONTRACTOR'S Final Construction Schedule, the CONTRACTOR shall monitor the progress of the WORK and adjust the schedule each month, as needed, to reflect actual progress and any changes in planned future activities, as a minimum for the following calendar month. Each schedule update submitted must be complete including all information requested. Each update shall continue to show all work activities including those already completed. These completed activities shall accurately reflect the "as built" information by indicating when the work was actually started and completed.

Neither the submission nor the updating of the CONTRACTOR'S original schedule submittal nor the submission, updating, change or revision of any other report, curve, schedule or narrative submitted to the ENGINEER by the CONTRACTOR under this Contract, nor the ENGINEER'S review or acceptance of any such report, curve, schedule or narrative shall have the effect of amending or modifying, in any way, the Contract completion date or milestone dates or of modifying or limiting, in any way, the CONTRACTOR'S obligations under this Contract. Only a signed, fully executed Change Order can modify these contractual obligations.

The monthly schedule update submittal will be reviewed with the CONTRACTOR during a monthly construction progress meeting held on the day of the 3rd project weekly meeting of each month. The goal of these meetings is to enable the CONTRACTOR and the ENGINEER to initiate appropriate remedial action to minimize any known or foreseen delay in completion of the WORK and to determine the amount of WORK completed since the last month's schedule update. The status of the WORK will be determined by the percent complete of each activity shown in the schedule. These meetings are considered a critical component of the overall monthly schedule update submittal and the CONTRACTOR shall have appropriate personnel attend. As a minimum, these meetings shall be attended by the CONTRACTOR'S Project Manager and General Superintendent. Within seven (7) working days after the monthly progress meeting, the CONTRACTOR shall submit the revised schedule and the CONTRACTOR'S Application for Payment. Within five (5) working days of receipt of the above noted revised submittals the ENGINEER will either accept or reject the monthly schedule update submittal. If accepted, the percent complete shown in the monthly update will be the basis for the Application for Payment to be submitted by the CONTRACTOR. If rejected, the update shall be corrected and resubmitted by the CONTRACTOR before the Application for Payment for the update period.

F. Schedule Revisions

The CONTRACTOR shall highlight or otherwise identify all changes to the Schedule Logic or activity durations made from the previous schedule. The CONTRACTOR shall modify any portions of the schedule which become infeasible because of activities behind schedule or for any other valid reason.

1.04 CHANGE ORDERS

- A. Upon approval of a change order, or upon receipt by the CONTRACTOR of authorization to proceed with additional work, the change shall be reflected in the next submittal of the schedule by the CONTRACTOR. The CONTRACTOR shall utilize a sub-network in the schedule depicting the changed work and its effect on other activities. This sub-network shall be tied to the main network with the appropriate logic so that a true analysis of the Critical Path can be made.

1.05 CONSTRUCTION SCHEDULES:

- A. Construction schedules shall include a graphic network or bar diagram.
- B. All construction activities and procurement shall be indicated in a time-scaled format and a calendar time line shall be shown along the entire sheet length. Each activity arrow or node shall be plotted so that the beginning and completion dates of each activity are accurately represented along the calendar time line. All activities shall be shown using the symbols that clearly distinguish between critical path activities, non-critical activities, and free float for each non-critical activity. All activity items shall be identified by Work Duration and their Dollar Value. All non-critical path activities shall show their total float time in scale form by utilizing a dotted line or some other graphical means.
- C. Float time shall be as follows:

1. Definition

Unless otherwise provided herein, float as referenced in these documents, is total float. Total float is the period of time measured by the number of working days each non-critical path activity may be delayed before it and its succeeding activities become part of the critical path. If a non-critical path activity is delayed beyond its float period, that activity then becomes part of the critical path and controls the end date of the project. Thus, the delay of the non-critical path activity beyond its float period will cause delay to the project itself. The 30 days "inclement weather" allowance may be included as part of the "float time".

2. Float Ownership

Neither the OWNER nor the CONTRACTOR owns the float time. The project owns the float time. Liability for delay of the project completion date rests jointly with the parties to this contract. Utilization of float time shall be prorated among the parties, and cost shall be allocated proportionately for delays beyond the float time, which will be proportionately allocated according to total delays which are the responsibility of the parties. For example, in general if Party A uses 80% of the float time and Party B later uses the remainder of the float time as well as additional time beyond the float time for an additional time equal to 20% of the float time. Total time would be 120% of float time, of which Party A would be responsible for two-thirds and Party B one-third. Party B would be liable for one-third and Party A would be liable for two-thirds of the costs associated with the time that represents a delay to the project's completion date.

1.06 PROJECT STATUS REPORTING

- A. The CONTRACTOR shall prepare monthly a revised schedule and written narrative reports of the status of the project for submission to the ENGINEER. Written status reports shall include:
1. The status of major project components (Percent Complete, amount of time ahead or behind schedule) and an explanation of how the project will be brought back on schedule if delays have occurred.
 2. The progress made on critical activities indicated on the schedule.
 3. Explanations for any lack of work on critical path activities planned to be performed during the last month.
 4. Explanations for any schedule changes, including changes to the logic or to activity durations.
 5. A list of the critical activities scheduled to be performed in the next two-month period.
 6. The status of major material and equipment procurement.
 7. The value of materials and equipment properly stored at the site, but not yet incorporated into the work-in-place.
 8. Any delays encountered during the reporting period.
 9. An assessment of inclement weather delays and impacts to the progress of the WORK.

The CONTRACTOR may include any other information pertinent to the status of the project. The CONTRACTOR shall include additional status information requested by the ENGINEER.

1.07 LIQUIDATED DAMAGES

- A. If any submittal required by this Section is determined by the ENGINEER to be incomplete or is submitted later than required, the OWNER will suffer financial loss and, accordingly, liquidated damages may be assessed against the CONTRACTOR in accordance with the Agreement.

2.00 PRODUCTS (Not Used)

3.00 EXECUTION (Not Used)

****END OF SECTION****

1.00 GENERAL

1.01 DESCRIPTION:

A. Work Included

1. Wherever possible throughout the Specifications, the minimum acceptable quality of workmanship and materials has been defined either by manufacturer's name and catalog number, or by reference to recognized industry standards.
2. To ensure that the specified products are furnished and installed in accordance with the design intent, procedures have been established for submittal of design data and review and approval or rejection by the Engineer prior to construction.

B. Special provisions, requirements, and/or revisions to this Specification and/or Bid Item(s) may be included in Section 01 01 00 (green pages) and/or on the Drawings or Details.

2.00 PRODUCTS

2.01 PRECONSTRUCTION SUBMITTAL

A. Submittals which are required prior to start of construction include construction schedule, Storm Water Pollution Prevention/Spill Prevention Plan, submittal register, and proposed list of major equipment.

2.02 MATERIAL SUBMITTALS AND SHOP DRAWINGS: (See also General Conditions)

A. Electronic Files

1. The Contractor may provide submittal in electronic format, with the exception of ones:
 - That include material samples
 - Greater than 40 pages in length
 - Include 24x36 or larger shop or detail drawings
2. Electronic submittals shall include a transmittal form clearly indicating the specific content of the submittal and certification the material has been reviewed by the Contractor prior to transmitting.
3. In addition to the electronic submittal, the Contractor shall provide 3 hard copies of the final submittal to the Engineer.
4. Hard copies of the submittals may be requested at the discretion of the Engineer. These shall be provided at no additional cost to the Owner.

B. Scale Required

Unless otherwise specifically directed by the Engineer, all Shop Drawings shall be accurately drawn to a scale sufficiently large to show pertinent features and method of connection to the work. On all Shop Drawings, figure dimensions shall be used, as opposed to scaled dimensions.

Drawings prepared specifically for the Contractor's use may require details which show how multiple

systems and interdisciplinary work will be coordinated.

2.03 MANUFACTURER'S LITERATURE:

A. General

1. Submitted literature shall include adequate information and data to ascertain conformance with the Contract plans and specifications. When applicable, the submitted literature shall include information regarding site storage requirements, installation requirements, MSDS information and any other information necessary for the incorporation of the material into the project scope.
2. Where the contents of submitted literature include data not pertinent to the submittal, the portion(s) of the contents being submitted for the Engineer's review shall be clearly indicated.

B. Number of Copies Required

A minimum of four (4) copies are required.

2.04 SAMPLES:

A. Accuracy of Sample

Unless otherwise specifically directed by the Engineer, all samples shall be of the exact article proposed to be furnished.

B. Number of Samples Required

All samples shall be submitted in the quantity required to be returned to the Contractor, plus two (2) to be retained by the Engineer.

2.05 COLORS:

Unless the precise color is specifically described in the Specification, whenever a choice of color or pattern is available in a specified product, accurate color charts shall be submitted to the Engineer for his review and selection.

2.06 SUBSTITUTIONS:

A. Engineer's Approval Required

1. Comply with the requirements of the General Conditions, unless modified herein.
2. The Contract is based on the materials, equipment, and methods described in the Contract Documents.

B. "Or Equal"

Where the phrase "or equal" occurs in the Contract Documents, do not assume that material, equipment, or methods will be approved as equal by the Engineer. See "GENERAL CONDITIONS,"

Article 6.

C. Reimbursement of Engineer's Costs

1. The Engineer will review the original submittal and one (1) resubmittal on each item. Subsequent submittal review will be at the Contractor's cost.
2. Reimbursement will be at the rate of 3.1 times the direct cost to the Engineer and his consultants for all the time spent by them in re-evaluation of the proposed resubmittal.

2.07 OPERATION AND MAINTENANCE MANUALS:

A. General

1. The Contractor shall furnish operation and maintenance manuals for all mechanical and electrical equipment furnished under this Contract. The manuals shall be bound in first quality, heavy duty 8-1/2" x 11", three-ring, loose leaf notebooks. Data shall be in the form of printed originals. Each equipment section shall be tabbed and labeled. Electronic submissions of Operation and Maintenance Manuals will not be accepted.

At a minimum, the manuals shall contain the following:

- a. A neatly typewritten index at the front of the manual, furnishing immediate information as to location of all sections of each piece of equipment;
- b. The front page of each section shall consist of a summary which contains the following information: name of firm, name and address of manufacturer, name plate information, name, address and telephone number of nearest representative, a summary of maintenance requirements, and a spare parts list;
- c. Complete instructions regarding operation and maintenance of all equipment involved;
- d. Complete nomenclature of all replaceable parts, their part numbers, current cost, and name and address of nearest vendor of parts;
- e. A copy of all guarantees and warranties issued;
- f. A copy of the Shop Drawings with all data concerning all changes made during construction.
- g. A signed copy of Electrical System Testing Report (page 7 of this Section) or as required in Division 16 of these Specifications.
- h. A signed copy of the Manufacturer's Final Inspection Report (page 9 of this Section).

B. Extraneous Data

Where the contents of manuals include manufacturer's catalog pages, the exact item(s) used in this installation shall be clearly indicated, and all manufacturers' data that is extraneous clearly deleted.

C. Number of Copies Required

Five (5) copies of manuals are required.

D. Schedule

Submit prior to 50% of project completion.

2.08 SUBMITTAL REGISTER

A. General

The Contractor shall maintain a Submittal Register as the work progresses. It shall show items of equipment and materials for which submittals are required by the specifications and submittal status. A current submittal register shall be submitted with each pay estimate request.

2.09 CLOSEOUT SUBMITTALS

A. General

Special requirements may be necessary to properly close out a construction contract. For example, Record Drawings, Warranty submittals and others may be required prior to the issuance of substantial and/or Final Completion. It is the Contractor's sole responsibility to comply with the necessary technical and/or administrative closeout requirements.

3.00 EXECUTION

3.01 IDENTIFICATION OF SUBMITTALS:

A. General

Each submittal shall be accompanied with a letter of transmittal showing the date of transmittal, Specification section(s), paragraph, and/or Drawing number to which the submittal pertains and a brief description of the material submitted.

B. Re-submittals

When material is re-submitted for any reason, it shall be submitted under a new letter of transmittal with reference to the previous submittal.

3.02 COORDINATION OF SUBMITTALS:

A. General

1. Prior to submittal for review by the Engineer, all data shall be fully coordinated, including the following:
 - a. All field dimensions and conditions;
 - b. All trades and public agencies involved, including necessary approvals;
 - c. All deviations from the approved plans and/or specifications.

B. Grouping of Submittals

1. All submittals shall be grouped with associated items, unless otherwise specifically permitted by the Engineer.
2. The Engineer may reject entire submittals, or portions thereof, as not complying with the provisions of the Contract Documents.

3.03 TIMING OF SUBMITTALS:

A. General

1. All submittals shall be made far enough in advance of installation to provide required time for all reviews, securing necessary approvals, possible revisions and resubmittals, placing orders, and securing delivery.
2. In scheduling, the Contractor shall allow at least ten (10) full working days for the Engineer's review, following his receipt of the submittal.

B. Delays

Cost of delays occasioned by tardiness of submittals on the part of the Contractor will not be borne by the Owner.

3.04 PROGRESS SCHEDULE: (See also General Conditions)

- A. A schedule of the proposed work and progress chart, showing the estimate time and dates for accomplishing the items of work within the time agreed upon for completion, shall be submitted to the Engineer within 10 days after the effective date on the Agreement. Furnish no less than four (4) copies.
- B. On a monthly basis, or as otherwise requested by the Engineer, Contractor shall submit an updated Construction Schedule that reflects actual progress. If the Contractor's work is not in conformance with the Construction Schedule, the Contractor shall take such actions as are necessary to bring the actual completion dates of its work activities into conformance with the Construction Schedule and Contract Time. In the event the Contractor does not submit an updated schedule on a monthly basis or

as otherwise requested by the Engineer, Payment of portions thereof may be withheld.

- C. Contractor shall notify the Engineer, either verbal or written, within 48 hours of any actual or anticipated event which is delaying, or could delay, any critical path activity of the work. Contractor shall, within 7 days, provide written documentation that indicates the expected duration of the delay, the anticipated effect of the delay on the Construction Schedule, and the action being, or to be, taken to correct the problem. Provisions of such notice do not relieve Contractor of his obligation to complete the work within the Contract Time.
- D. Acceptance of the Construction Schedule does not constitute acceptance of Contractor's construction means, methods, or sequencing.

3.05 RECORD DRAWINGS:

The Contractor will be furnished with one (1) set of drawings designated as "RECORD DRAWINGS". During the progress of the work, the Contractor shall maintain an accurate record of all changes to the Record Drawings. Such changes shall be entered on the drawings with red ink only. The drawings shall be submitted to the Engineer prior to project closeout and final payment approval.

****END OF SECTION****

ELECTRICAL SYSTEM TESTING REPORT
PAGE 1 OF 2

DESCRIPTION: _____

SERVICE DESCRIPTION:

Nominal Voltage Phase to Neutral Number of Conductors: _____
 Phase to Phase Single or 3-phase

SERVICE CONDUCTORS:

Phase Size: _____ Insulation Type: _____
 Neutral Size: _____ Insulation Type: _____
 Ground Size: _____ Insulation Type: _____

SERVICE DISCONNECT DESCRIPTION:

Circuit Breaker Size (amps): _____
 Disconnect Switch Fuse (amps): _____

MEASURED CONDITIONS*		DATA		
Operating Load Voltage	Volts	Vab _____	Vbc _____	Vca _____
Operating Load Feeder Current	Amps	la _____	lb _____	lc _____
Conductor Insulation	Megohms	a-b _____	b-c _____	c-a _____
Resistance				
1. Service Feeder	Megohms	a-g _____	b-g _____	c-g _____
2. Pump Feeders	Megohms	a-g _____	b-g _____	c-g _____

**All testing shall be done in the presence of the Engineer*

CONTRACTOR'S REPRESENTATIVE

DATE

OWNER'S REPRESENTATIVE

DATE

MOTOR DATA AND TEST REPORT
PAGE 2 OF 2

EQUIPMENT NAME: _____ **NUMBER:** _____

EQUIPMENT SPECIFICATION SECTION: _____

MOTOR STARTER LOCATION: _____

MOTOR NAMEPLATE DATA

MFR Name: _____	MFR Model No.: _____
Voltage: _____	Phase: _____
HP: _____	Service Factor: _____
Efficiency Index (or %): _____	NEMA Design: _____
Code Letter: _____	Insulation Type: _____
Temperature Rise: _____	Ambient Temp: _____
RPM: _____	Enclosure: _____
Thermal Trip Setting: _____	Space Htr Watts: _____
Other Data: _____	Space Htr Volts: _____

MOTOR STARTER INFORMATION

Manufacturer / Type _____
Overload Heater No.: _____

MEASURED CONDITIONS*		DATA		
Full Load Operating Voltage**	Volts	a-g _____	b-g _____	c-g _____
Full Load Operating Voltage	Volts	a-b _____	b-c _____	c-a _____
Full Load Operating Current	Volts	a _____	B _____	c _____
Insulation Resistance (deenergized)	Megohms	a-g _____	b-g _____	c-g _____
Motor Circuit Resistance	Ohms	a-b _____	b-c _____	c-a _____

**All testing shall be done in the presence of the Engineer*

***Voltage and current readings shall be taken at the closest accessible point to the load.*

CONTRACTOR'S REPRESENTATIVE DATE

OWNER'S REPRESENTATIVE DATE

CHECK POINTS

Installation <i>(fasteners, dimensions, plumb / level)</i>	Mechanical <i>(adequate piping, support, valving)</i>	Functional Test <i>(rotation, electrical, motor)</i>
<input type="checkbox"/> Pass <input type="checkbox"/> Fail	<input type="checkbox"/> Pass <input type="checkbox"/> Fail	<input type="checkbox"/> Pass <input type="checkbox"/> Fail

REMARKS:

ITEMS REMAINING TO COMPLETION

The below described areas and items have been found to be deficient. No guarantee can be issued until they are corrected. These items will also require re-inspection:

I have inspected the above described _____ and:

- Recommend a warranty be issued.
- Feel the _____ will require additional work before a warranty is issued.

 MANUFACTURER’S REPRESENTATIVE

 DATE

 OWNER’S REPRESENTATIVE

 DATE

SUBMITTAL TRANSMITTAL

PROJECT: _____ **DATE:** _____

SUBCONTRACTOR: _____ **ATTN:** _____

SUPPLIER: _____

SPEC SECTION (only one per form): _____ **TRANS. NO.:** _____

Hand Delivered
 Faxed
 UPS
 First Class Mail
 Email

SPEC PARA #	DRWG #	DESCRIPTION & USE OF EQUIPMENT	ENG. ACTION TAKEN ⁽¹⁾

By this submittal, the Contractor represents that he has determined and verified all field measurements, field construction criteria, materials, catalog numbers, and similar data, or will do so, and that he has checked and coordinated each Shop Drawing with the requirements of the work and the Contract Documents.

 Contractor's Signature Date

SUBMITTAL REVIEW ACTION BY ENGINEER

⁽¹⁾ ENGINEER ACTION DESCRIPTION:

- | | |
|--------------------------|------------------------|
| A. NO EXCEPTION TAKEN | D. ACCEPTED AS NOTED |
| B. REJECTED | E. REVISE AND RESUBMIT |
| C. SUBMIT SPECIFIED ITEM | F. INFORMATION ONLY |

Checking is only for general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Any action shown is subject to the requirements of the plans and specifications. Contractor is responsible for dimensions which shall be confirmed and correlated in the field, fabrication processes and techniques of construction, coordination of his or her work with that of all other trades, and the satisfactory performance of his or her work in full compliance with the Contract Documents.

VARELA & ASSOCIATES, INC.

By: _____ Date: _____

COMMENTS: _____

1.00 GENERAL

- A. The Contractor shall be responsible for conducting his work and operations in accordance with all pertinent codes and regulations and latest revisions thereof, including, but not necessarily limited to, the following:
1. American Concrete Institute (ACI)
 2. American Institute of Steel Construction (AISC)
 3. American Plywood Association (APA)
 4. American Public Works Association (APWA)
 5. American Society for Testing and Materials (ASTM)
 6. American Water Works Association (AWWA)
 7. Concrete Reinforcing Steel Institute (CRSI)
 8. International Conference of Building Officials (ICBO)
 9. Local Building Code(s)
 10. National Electrical Code (NEC)
 11. National Fire Protection Codes (NFPA)
 12. Revised Code of Washington (RCW)
 13. Steel Structures Painting Council (SSPC)
 14. Underwriter's Laboratory (UL)
 15. International Building Code (IBC)
 16. Uniform Plumbing Code (UPC)
 17. Washington State Energy Code
 18. Washington Department of Labor & Industries (L&I)
 19. Western Wood Products Association (WWPA)
- B. Special provisions, requirements, and/or revisions to this Specification and/or Bid Item(s) may be included in Section 01 01 00 (green pages) and/or on the Drawings or Details.

****END OF SECTION****

1.00 GENERAL

1.01 CONTRACTOR'S PLANT AND EQUIPMENT:

A. General

1. It shall be the Contractor's responsibility to provide plant and equipment that is adequate for the performance of the work under this Contract within the time specified and at the Contractor's expense. All plant and equipment shall be kept in satisfactory operating condition and shall be capable of safely and efficiently performing the required work. It shall be the Contractor's sole responsibility to ensure that all work areas, construction work, and facilities are safe, adequate, and in conformance with the applicable requirements of local, state, and federal safety codes, standards and regulations.
2. Special provisions, requirements, and/or revisions to the specifications may be included in Section 01 01 00 (green pages) and/or on the Drawings.

B. Separate Contracts

Whenever portions of the work hereunder are let under separate contracts, all of the provisions of this Section shall apply to each such prime contractor, including requirements for separate field offices and communications facilities.

C. Temporary Illumination

1. Furnish a temporary illumination system that will provide adequate illumination of building areas as required to maintain a high level of workmanship for all trades. In addition, provide adequate security and safety lighting for all stairways, corridors, passageways and other work areas, as required for pathway lighting, throughout the site and buildings.
2. Provide and maintain security lighting as appropriate to provide general illumination of the work area during night time hours.

D. Construction Wiring

All wiring for temporary electric light and power shall be installed and maintained in first-class manner and shall be securely fastened in place.

E. Separation of Circuits

Circuits separate from lighting circuits shall generally be used for all power purposes.

F. Fire Protection

The construction plant and all other parts of the work shall be adequately protected against damage by fire. Hose connections and hose, water casks, chemical equipment, or other sufficient means shall be provided for fighting fires in the temporary structures and other portions of the work, and responsible persons shall be designated and instructed in the operation of such fire apparatus so as to prevent or minimize the hazard of fire.

1.02 UTILITIES:

A. Water Supply

1. General

Water for construction and testing purposes will be supplied to the Contractor, at no cost, from the city water system at the location of a hydrant as close as practical to the construction site. The Contractor shall provide a water meter and contact the Owner for other requirements prior to using city water. It shall be the responsibility of the Contractor to transport the water to the site, to utilize and control water at the site, and to coordinate with City personnel regarding connection to the city water system. The Contractor shall not waste water.

2. Water

- a. All costs of temporary piping and appurtenances, removal of same, and restoration of Owner's utilities at the completion of work shall be paid by the Contractor.
- b. Piping of temporary water service shall not exceed the capacity of the Owner's system.
- c. The Contractor shall provide drinking water from a proven safe source for all those connected with the work.
- d. Pipe or transport water in such a manner as to keep it clean and fresh.

3. Removal of Water Connections

Before final acceptance of the work on the project, all temporary connections and piping installed by the Contractor shall be entirely removed, and all affected improvements shall be restored to their original condition, or better, to the satisfaction of the Engineer and Owner.

B. Sanitary Facilities

Facilities for the sanitary use of all personnel employed on the project, beginning with the first person employed, shall be furnished and maintained by the Contractor in the number, manner, and places as required by local and state codes. The Contractor shall rigorously prohibit actions which may cause a nuisance to the general public.

C. Power

1. Power

The Contractor shall provide, at his own expense, all necessary power required for his operations under this Contract, and shall provide and maintain all temporary power lines required to perform the work in a safe and satisfactory manner.

2. Approval of Electrical Connections

- a. All temporary connections for electricity shall be subject to approval from the power company and shall be removed in like manner at the Contractor's expense, prior to final acceptance of the work.
- b. All costs of transformers, cable, installation, and removal at the completion of the work shall be paid for by the Contractor.
- c. All temporary equipment shall be installed and maintained in accordance with all applicable safety regulations.

D. Telephone

The Contractor shall provide and maintain at all times during the progress of the work, at his own expense, not less than one telephone in good working order, as well as a high speed internet connection, at his own field construction office.

E. Temporary Sedimentation Controls

The Contractor is solely responsible for planning and implementing such actions, facilities, and structural controls as required during the course of construction to ensure that no silt or mud enters any watercourse, surface water, or drainage ditch and that no erosion occurs in any disturbed areas.

F. Temporary Heat

1. The Contractor shall provide temporary heat as required to protect materials and equipment from dampness and cold.
2. The method of heating is subject to approval of the Engineer.

1.03 SAFETY:

A. General

Appropriate first aid facilities and supplies shall be kept and maintained by the Contractor at the site of the work. All persons within the construction area shall be required to wear protective helmets. In addition, all employees of the Contractor and his subcontractors shall be provided with, and required to use, personal protective and life saving equipment as set forth in the applicable Safety and Health Standards. The Contractor shall make available protective helmets for use by project visitors.

B. Public Safety

During the performance of the work, the Contractor shall erect and maintain temporary fences, bridges, railings and barriers, shall take all other necessary precautions, and shall place proper guards for the prevention of accidents, and he shall erect and maintain suitable and sufficient lights and other signals.

C. Fire Safety

1. The Contractor shall conduct his operations in a fire-safe manner, subject to approval of the Owner or his authorized representative.
2. The Contractor shall provide and maintain a sufficient number of fire extinguishers of the proper type in locations readily available in case of a fire.
3. The Contractor shall clear the premises of excessive rubbish and debris.
4. The Contractor shall comply with the applicable provisions of the governing fire code which, by reference, shall be incorporated into these specifications.
5. The Contractor shall immediately correct any deficiencies brought to his attention.
6. Where significant or continued non-compliance is noted, the Owner reserves the right to stop the work, at no extra cost or extension of time, pending remedial action.

1.04 PROTECTION OF EXISTING UTILITIES:

See Sections 01 01 00 and 01 10 00.

1.05 CONSTRUCTION DEBRIS REMOVAL:

- A. All refuse and waste material shall be disposed of by the Contractor off of the Owner's property.
- B. Waste material shall not be stockpiled on the Owner's property.
- C. Immediately clean up any spilled material from buildings, road, etc.

1.06 NOISE CONTROL:

A. Intent

The purpose of this specification is to keep the level of construction noise inside adjacent existing buildings and/or rooms from exceeding a DBA 55 curve (with windows closed) during all occupied hours. The Contractor may meet this criterion by erecting barriers between equipment noise attenuators.

B. Outdoor Vehicle and Internal Combustion Engine Noise

Noise levels of each piece of equipment shall no be greater than 86 DBA at a distance of 50 feet, as measured under the noisiest operating conditions, but in no case shall exceed state or local standards. Rubber-tired equipment will be used whenever possible, instead of equipment with metal tracks.

C. Indoor Noise

Use of noise-producing vehicles and equipment within existing buildings is subject to Owner's approval.

D. Air Compressors

Provide equipment with silencing packages. Electric driven preferred.

****END OF SECTION****

1.00 GENERAL

The Contractor shall furnish, install, and maintain a field office at the project site for use by the Engineer.

1.01 GENERAL FIELD OFFICE REQUIREMENTS:

- A. Prior to issuing a Notice To Proceed, the Contractor shall provide information to the Engineer regarding proposed field office accommodations including location, description, and confirmation that the items of this Specification are included. The Contractor shall make the office facility available for inspection by the Engineer, prior to his approval of the field office.
- B. A field office, equipped as specified herein, shall be provided and ready for use by the Engineer within fifteen (15) working days after receipt by the Contractor of written Notice to Proceed. The Contractor's attention is directed to the condition that no payment for mobilization, or any part thereof, will be approved for payment under the Contract until all field office facilities specified herein have been provided as specified and approved by the Engineer.
- C. Unless released earlier by the Engineer in writing, the field office shall be maintained in full operation at the site, with all utilities connected and operable until final Notice of Completion has been issued. Upon issuance of final Notice of Completion, or upon early release of the field office by the Engineer, the Contractor shall remove the field office within ten (10) working days from said date, and shall restore the site occupied by said field office.

1.02 PHONE SERVICE:

The Contractor shall provide and maintain at all times during the progress of the work, at his own expense, one phone connection, at the Engineer's field construction office. The phone line shall be a secure dedicated phone line to the Engineer's office. The Contractor shall be responsible for the line connection and monthly charges for the duration of the Contract.

1.03 INTERNET SERVICE:

The Contractor shall provide and maintain at all times during the progress of the work, at his own expense, one high speed internet connection, at the Engineer's field construction office. The connection shall be a secure dedicated service to the Engineer's office with the highest available broadband with unlimited download and upload and capable of video conferencing. The Contractor shall be responsible for their connection and monthly charges for the duration of the Contract.

1.04 OFFICE FACILITIES:

A. General

The Contractor shall furnish and install all necessary electrical wiring, air conditioning, heating equipment, plumbing, appliances, office furniture, equipment, and shelving and shall furnish all necessary light, heat, air conditioning, water and sanitation facilities, maintenance / upkeep, and weekly janitorial services in connection with all field offices specified herein for the duration of the work.

B. Field Office Requirements

1. In addition to the Contractor's field office, the Contractor shall provide and maintain for the exclusive use of the Engineer and the Owner's representative and personnel, a separate, lockable, well-lighted, air conditioned and electrically heated field office capable of automatically maintaining an office temperature of 72° F during all seasons.
2. Location of the field office facility shall be at a location acceptable to the Engineer and shall be located away from areas with odors and/or other aesthetic issues.
3. The field office space shall include a separate private single bedroom facility with bathroom (water closet, sink, vanity, and shower), kitchen (w/ sink, cupboards, stove, microwave, refrigerator) and office space. The area of the space shall be a minimum of 600 square feet with 8' ceil height. Private bedroom, kitchen, and living areas shall be in good condition, clean, and acceptable to the Engineer.
4. Shall including minimum 2 windows per room (except bathroom, closets, and utility room) with security bars. Provide blinds for all windows.
5. All equipment is to be new, or like new. The Contractor shall maintain or replace failed or malfunctioning equipment within 48-hours. Owner reserves the right to lease/purchase replacement equipment at the Contractor's expense.
6. Equipment and facility furnishings shall include:
 - a. One (1) computer (Dell Precision 5820 with 32" LCD monitor or approved equal).
 - b. One (1) all-purpose printer: minimum features include, 11"x17" capability, color, 2-side printing, copying, scanning, wireless.
 - c. One (1) video conferencing system to include min 42" wall mounted LCD monitor/screen, wireless video conferencing system hardware including camera, interface and software
 - d. One (1) each: standard 30" x 60" table.
 - e. Two (2) each: standard 30" x 60" desk, each with not less than three (3) drawers (or equal).
 - f. One (1) each: legal sized, 4-5 drawer file cabinet.
 - g. Two (2) each: office chair, standard arm rest type, adjustable, swivel, tilt-back with casters.
 - h. Four (4) each: Office chairs, still-leg type, with arm rests.
 - i. One (1) each: 36" x 42" dry erase board.

- j. One (1) each: wall-mounted cork board for thumbtacks, 4' x 4' minimum.
- k. Two (2) each: standard wastebaskets.
- l. One (1) each: refrigerated bottled water dispenser unit and bottled water and paper cup supply, or refrigerator.
- m. Twenty (20) linear feet of shelving or bookshelves (heavy duty).
- n. Bedroom Furniture: one (1) double bed (frame, box spring, mattress), and one (1) 4 drawer clothes dresser.
- o. Kitchen Utilities: standard size refrigerator, and microwave.
- p. First Aid Supplies: Comply with governing regulations.
- q. Fire Extinguishers: Provide hand-carried, portable UL-rated, class "A" fire extinguishers for temporary offices and similar spaces. In other locations provide hand-carried, portable, UL- rated, class "ABC" dry chemical extinguishers, or a combination of extinguishers of NFPA recommended classes for the exposures.

Comply with NFPA 10 and 241 for classification, extinguishing agent and size required by location and class of fire exposure.

1.05 FIELD OFFICE SERVICES

- A. Each field office as required herein shall be provided with sufficient interior lighting. Exterior lighting shall be provided over the entrance door.
- B. Regular weekly janitorial services shall be provided. Facility services shall include vacuuming, sweeping, dusting, garbage disposal, bathroom / kitchen cleaning and linen cleaning.
- C. Security measures and supervision of the area shall be the responsibility of the Contractor.

****END OF SECTION****

1.00 GENERAL

1.01 GENERAL:

- A. Materials and equipment furnished and installed shall be manufactured, fabricated, or constructed to meet all applicable safety requirements.
- B. All material and equipment supplied by the Contractor and incorporated in this project shall be of new manufacture and, when required by the Engineer, a certificate shall be supplied attesting to this fact. Owner-supplied materials to be used, if any, will be specifically noted on the Drawings or within the Specifications.
- C. All tools and equipment used for construction operations shall be of the size and type suitable for the work to be performed and shall be kept in a good state of repair.
- D. Special provisions, requirements, and/or revisions to this Specification and/or Bid Item(s) may be included in Section 01 01 00 (green pages) and/or on the Drawings or Details.

1.02 QUALITY:

The Contractor shall, whenever required during the progress of the work and after completion of construction, furnish proof acceptable to the Owner that all items installed equal or exceed all requirements specified in these Contract Documents.

1.03 HANDLING:

A. Protection

The Contractor shall use all means possible to protect materials and equipment before, during and after installation.

B. Replacement

The Contractor shall replace any damaged materials or equipment to the approval of the Engineer, at his own cost.

1.04 STORAGE:

The Contractor shall store all equipment and materials in a safe, dry place as to prevent any deterioration of the product's quality.

****END OF SECTION****

1.00 GENERAL

1.01 GENERAL:

Materials and equipment furnished shall be delivered, handled, and stored in accordance with manufacturer's recommendations and the provisions of this section.

1.02 DELIVERY:

- A. Deliver, store, and handle products in accordance with the manufacturer's recommendations, using means and methods that will prevent damage, deterioration, and loss, including theft.
- B. Schedule delivery to minimize long-term storage at the site and to prevent overcrowding of construction spaces.
- C. Coordinate delivery with installation time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, or other losses.
- D. Deliver products to the site in the manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing. Labels to include:
 - 1. Name of product.
 - 2. Name of manufacturer.
 - 3. Date of manufacture, where applicable.
 - 4. Shelf life, where applicable.
 - 5. Quality of grade, where applicable.
 - 6. Lot number, where applicable.
 - 7. Fire performance characteristics, where applicable.

1.03 STORAGE

- A. The Contractor shall be responsible for obtaining and maintaining storage sites required for his use. Within the limitations of these Specifications, site and operational restrictions, and approval of the Owner and Engineer, portions of the project site may be used for storage.
- B. Store products in a manner that will facilitate inspection and measurement of quantity or counting of units.
- C. Store heavy materials away from the project structure in a manner that will not endanger the supporting construction.

DELIVERY AND STORAGE

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- D. Store products subject to damage by the elements above ground, under cover in a weather tight enclosure, with ventilation adequate to prevent condensation. Maintain temperature and humidity within range required by manufacturer's instructions.
- E. Perform appropriate service and maintenance work to prevent damage.

****END OF SECTION****

FORM 01 75 00-1 INSTRUMENT CALIBRATION FORM

SELLER NAME:			PROJECT NAME:				
TAG NO.:			LOCATION/SERVICE:				
MANUFACTURER:			SPECIFICATION SECTION:				
MODEL NUMBER:			SERIAL NO.:				
REQUIRED SCALE 4-20 mA:			UNITS:				
ANALOG CALIBRATION							
SIMULATED INPUT		READING					
		RISING			FALLING		
%SPAN	ACTUAL	ACTUAL	%SPAN	%ERROR	ACTUAL	%SPAN	%ERROR
0							
25							
50							
75							
100							
DISCRETE OUTPUT CALIBRATION							
	REQUIRED			READING			
TAG NUMBER	TRIP POINT	RESET POINT	RISING OR FALLING	TRIP POINT	RESET POINT	RISING OR FALLING	
COMMENTS:							
	SELLER CHECK OFF		CONTRACTOR CHECK OFF		WITNESS CHECK OFF		
NAME							
SIGNATURE							
DATE							

FORM 01 75 00-2 CONTROL VALVE CALIBRATION FORM

SELLER NAME:	PROJECT NAME:
PID TAG NO.:	VALVE SCHEDULE TAG NO:
MANUFACTURER:	SPECIFICATION SECTION:
MODEL NUMBER:	SERIAL NO.:
VALVE OPERATOR TYPE:	PNEUMATIC OPERATOR SUPPLY PRESSURE:
FAIL OPEN OR CLOSE:	ELECTRICAL POWER SUPPLY:

ANALOG CALIBRATION

SIMULATED INPUT		READING					
VALVE POSITION %	INPUT (mA)	OPENING			CLOSING		
		ACTUAL INPUT (mA)	VALVE POSITION %	ERROR %	ACTUAL INPUT (mA)	VALVE POSITION %	ERROR %
0							
25							
50							
75							
100							

DISCRETE OUTPUT CALIBRATION

LIMIT SWITCH TAG NUMBER	REQUIRED		READING		VALVE FAIL POSITION TEST	
	POSITION TRIP POINT (%)	POSITION RESET POINT (%)	POSITION TRIP POINT (%)	POSITION RESET POINT (%)	VALVE FAIL CONDITION	POSITION
					LOSS OF AIR	
					LOSS OF POWER	

COMMENTS:

	SELLER CHECK OFF	CONTRACTOR CHECK OFF	WITNESS CHECK OFF
NAME			
SIGN			
DATE			

FORM 01 75 00-3 CERTIFICATE OF INSTALLATION AND TESTING OF PUMPS

SELLER NAME:		PROJECT NAME:				
EQUIPMENT SCHEDULE NO.:		NAME OF EQUIPMENT:				
LOCATION/SERVICE:		SPECIFICATION SECTION:				
MANUFACTURER:		SUCTION/DISCHARGE SIZE (INCHES):				
MODEL NUMBER:		SERIAL NO.:				
DESIGN FLOW (GPM):	TDH (FEET):	PUMP RPM:	IMPELLER SIZE (INCHES):			
MOTOR HP:	VOLTS:	HERTZ:	PHASE:			
FLA:	MOTOR RPM:	SERVICE FACTOR:	MOTOR EFFICIENCY:			
INSTALLATION INSPECTION (CHECK IF VERIFIED)						
PIPE SUPPORTS:	PIPE FLUSHED:	PRESSURE TEST:	TEST PRESSURE:			
BASE ANCHORED/ GROUTED:	PRESSURE GAUGES:	EXPANSION COUPLINGS:	ISOLATION/CHECK VALVES:			
SHAFT ALIGNMENT:	LUBRICATION:	PROPER ROTATION:	V-BELT TENSION:			
SUPPLY VOLTAGE:	MOTOR GROUNDING:	GUARDS/SAFETY:	OTHER:			
PERFORMANCE TEST						
SPEED	INLET PRESSURE GAUGE (PSI/FT)	DISCHARGE PRESSURE GAUGE (PSI/FT)	DISCHARGE FLOW (GPM)	PUMP SPEED (RPM)	VFD OUTPUT CURRENT (AMPS)	VFD OUTPUT VOLTAGE (VOLTS)
0% (STATIC)			0	0	0	0
MIN.						
50% / 30 HZ						
75% / 45 HZ						
100% / 60 HZ						
PUMP/MOTOR VIBRATION TEST				VFD SETTINGS		
PUMP MAX. VIBRATION (IN/S RMS):			VFD MINIMUM SPEED SETTING (HZ):			
MOTOR MAX. VIBRATION (IN/S RMS):			VFD OVERLOAD SETTING (AMPS):			
CHECK VALVE/FLOW LIMIT SWITCH TAG NO.:			VFD TIME TO ACCELERATION SETTING (S):			
LIMIT SWITCH SHUT OFF/ALARM CHECK:			VFD TIME TO DECELERATION SETTING (S):			
	SELLER/MANUFACTURER CHECK OFF		CONTRACTOR CHECK OFF		WITNESS CHECK OFF	
NAME						
SIGNATURE						
DATE						

FORM 01 75 00-4 CERTIFICATE OF INSTALLATION AND TESTING OF BLOWERS

SELLER NAME:				PROJECT NAME:					
EQUIPMENT SCHEDULE NO.:				NAME OF EQUIPMENT:					
LOCATION/SERVICE:				SPECIFICATION SECTION:					
MANUFACTURER:				DISCHARGE SIZE (INCHES):					
MODEL NUMBER:				SERIAL NO.:					
AIR FLOW (CFM):		DELTA P (PSI):		BLOWER RPM:		GEAR SIZE (INCHES):			
MOTOR HP:		VOLTS:		HERTZ:		PHASE:			
FLA:		MOTOR RPM:		SERVICE FACTOR:		MOTOR EFFICIENCY:			
INSTALLATION INSPECTION (CHECK IF VERIFIED)									
PIPE SUPPORTS:		PIPE CLEANED:		PIPE PRESSURE TEST:		TEST PRESSURE:			
BASE ANCHORED/ GROUTED:		PRESSURE GAUGES:		EXPANSION COUPLINGS:		ISOLATION/CHECK VALVES:			
SHAFT ALIGNMENT:		LUBRICATION:		PROPER ROTATION:		V-BELT TENSION:			
SUPPLY VOLTAGE:		MOTOR GROUNDING:		GUARDS/SAFETY:		ENCLOSURE INTEGRITY:			
PERFORMANCE TEST									
SPEED	INLET PRESSURE (PSI/IN.)	DISCHARGE PRESSURE (GAUGE) (PSI/IN.)	DISCHARGE PRESSURE (TRANSDUCER) (PSI/IN.)	DISCHARGE AIR FLOW (CFM)	DISCHARGE TEMP. (DEG. F)	BLOWER SPEED (RPM)	CURRENT (AMPS)	NOISE (DBA)	VOLTAGE (VOLTS)
0% (STATIC)				0		0	0		0
MIN.									
50% / 30 HZ									
75% / 45 HZ									
100% / 60 HZ									
VIBRATION TESTS AND SAFETY SWITCHES					VFD SETTINGS				
BLOWER MAX. VIBRATION (IN/S RMS):					VFD MINIMUM SPEED SETTING (HZ):				
MOTOR MAX. VIBRATION (IN/S RMS):					VFD OVERLOAD SETTING (AMPS):				
FLOW LIMIT SWITCH TAG NO.:					VFD TIME TO ACCELERATION SETTING (S):				
LIMIT SWITCH ON/OFF/ALARM CHECK:					VFD TIME TO DECELERATION SETTING (S):				
DISCHARGE PRESSURE SWITCH TAG. NO.					DISCHARGE TEMPERATURE SWITCH TAG. NO.				
PRESSURE SWITCH SHUT OFF/ALARM CHECK:					TEMPERATURE SWITCH SHUT OFF/ALARM CHECK				
	SELLER/MANUFACTURER CHECK OFF			CONTRACTOR CHECK OFF			WITNESS CHECK OFF		
NAME									
SIGNATURE									
DATE									

FORM 01 75 00-5 CERTIFICATE OF INSTALLATION AND TESTING OF COMPRESSORS

SELLER NAME:		PROJECT NAME:	
EQUIPMENT SCHEDULE NO.:		NAME OF EQUIPMENT:	
LOCATION/SERVICE:		SPECIFICATION SECTION:	
MANUFACTURER:		DISCHARGE SIZE (INCHES):	
MODEL NUMBER:		SERIAL NO.:	
AIR FLOW (CFM):	DISCHARGE PRESSURE (PSI):	RPM:	STAGES:
MOTOR HP:	VOLTS:	HERTZ:	PHASE:
FLA:	MOTOR RPM:	SERVICE FACTOR:	MOTOR EFFICIENCY:
INSTALLATION INSPECTION (CHECK IF VERIFIED)			
PIPE SUPPORTS:	PIPE CLEANED:	PIPE PRESSURE TEST:	TEST PRESSURE:
BASE ANCHORED/ GROUTED:	PRESSURE GAUGES:	EXPANSION COUPLINGS:	ISOLATION/PRV VALVES:
SHAFT ALIGNMENT:	LUBRICATION:	PROPER ROTATION:	V-BELT TENSION:
SUPPLY VOLTAGE:	MOTOR GROUNDING:	GUARDS/SAFETY:	ENCLOSURE INTEGRITY:
PERFORMANCE TEST			
SPEED AT 60 HZ:		DISCHARGE PRESSURE AT 60 HZ (PSI):	
MOTOR CURRENT AT 60 HZ (AMPS)		MOTOR VOLTAGE AT 60 HZ:	
VIBRATION AT 60 HZ (IN/S RMS):		NOISE (DBA) AT 60 HZ	
RECEIVER PRESSURE SWITCH TAG NO.:		PRESSURE SWITCH ALARM CHECK:	
MANUAL/AUTO OPERATION:		LEAD/LAG SEQUENCING:	
CONTROL PANEL AUTO STATUS:		INDICATING LIGHTS CHECK:	
AUTO DRAIN VALVE CHECK:		OTHER:	
COMMENTS:			
	SELLER/MANUFACTURER CHECK OFF	CONTRACTOR CHECK OFF	WITNESS CHECK OFF
NAME			
SIGNATURE			
DATE			

FORM 01 75 00-6 CERTIFICATE OF INSTALLATION AND TESTING - EQUIPMENT

Name Plate Data:

Name of Equipment: _____ Equipment Schedule No. _____
Location: _____ Specification Section: _____
Name of Manufacturer: _____ Size: _____
Serial No.: _____ Model: _____
Motor HP: _____ RPM: _____ Phase: _____ Volts: _____ Hertz: _____ FLA: _____

Installation Inspection (Check if Verified):

Manufacturer's Installation Checklist Submitted: _____ Instrument Calibration Forms Submitted: _____
Supports Anchored: _____ Plumbed/Leak Tested: _____ Basin Leak Test: _____ Basin Cleaned: _____
Shaft Alignment: _____ Lubrication: _____ Rotation: _____ V-Belt Tension: _____ Guards/Safety: _____
Supply Voltage: _____ Instrumentation: I-O Checkout: _____ Other: _____
Missing Equipment/Spare Parts: _____

Performance Test:

Speed at 60 Hz: _____ Vibration Acceptable: _____
Motor Current at 60 Hz: _____ Motor Voltage at 60 Hz: _____
VFD Minimum Speed Setting (Hz): _____ VFD Overload Setting (Amps): _____
VFD Time to Acceleration Setting (s): _____ VFD Time to Deceleration Setting (s): _____
Motor Test Report Submitted: _____

System Functional Test:

Transmitter Tag No.: _____ Scale 4-20 mA: _____
Transmitter On/Off/Alarm Settings: _____
Transmitter Tag No.: _____ Scale 4-20 mA: _____
Transmitter On/Off/Alarm Settings: _____
E-Stop Tag No.: _____ Shut-Off Verification: _____
High Torque Alarm Tag Nos.: _____ Alarm/Shut-Off Verification: _____
Status Indication Verification: _____ Position Indication Verification: _____
Equipment Control Panel Auto Operation Verification: _____
Comments: _____

Tested By: _____ Date of Test: _____
(Signature) Contractor or Contractor's Representative

Witnessed By: _____ Date: _____
(Signature) Engineer or Engineer's Representative

As the Manufacturer's Representative, I certify that I have inspected the installation of the equipment, the equipment has been installed in accordance with the manufacturer's recommendations, I have witnessed all applicable field tests, all proper adjustments have been made, the equipment meets the performance requirements of the Contract Specifications, and the equipment is ready for plant commissioning and operation.

Certified By: _____ Date: _____
(Signature) Manufacturer's Representative

FORM 01 75 00-7 CERTIFICATE OF TRAINING

Name of Equipment: _____

Specification Section: _____

Name of Manufacturer: _____

Equipment Schedule Nos. _____

Training Requirements (Check if Verified):

1. Operation and Maintenance (O&M) Manuals available – provide one paper copy to each trainee. _____
2. O&Ms - Familiarize with outline, catalog, parts lists, shop drawings, etc. _____
3. Drawings - Identify equipment components, features, and layout. _____
4. Safety – Review safety features, requirements, lock-out, and control interlocks. _____
5. Operation - Describe operating procedures – start-up, shut-down, normal, and emergency. _____
6. Disassembly – Demonstrate removal, disassembly, assembly, installation, and storage. _____
7. Normal Maintenance – Instruct on normal preventative maintenance procedures and cleaning. _____
8. Calibration – Instruct on calibration of measuring instruments, as applicable. _____
9. Lubrication – Identify lubrication requirements and schedule. _____
10. Troubleshooting – Identify checklist and instruct on troubleshooting procedures. _____
11. Corrective Maintenance – Provide overview of possible problems and corrective procedures. _____
12. Parts – Identify parts list, procedures for ordering, equipment repairs, and replacement of parts. _____
13. Spare Parts - Identify those that are on-site and those that are recommended. _____
14. Special Tools – Identify and describe the use of any special tools required. _____
15. Local Representatives – Identify contacts for ordering parts or servicing equipment. _____

Owner's Staff Receiving Training

1. _____ Date: _____
(Signature) Owner's Staff

2. _____ Date: _____
(Signature) Owner's Staff

3. _____ Date: _____
(Signature) Owner's Staff

4. _____ Date: _____
(Signature) Owner's Staff

5. _____ Date: _____
(Signature) Owner's Staff

Witnessed By: _____ Date: _____
(Signature) Engineer or Engineer's Representative

As the Manufacturer's Representative, I certify that I have instructed the above Owner's personnel in the proper operation and maintenance of the equipment indicated above and have covered the above topics during training.

Certified By: _____ Date: _____
(Signature) Manufacturer's Representative

1.00 GENERAL

1.01 DESCRIPTION OF WORK

- A. Work covered by this section consists of furnishing all labor, materials, and utilities required to functionally test the equipment and appurtenances specified in the technical specifications. The scope of work shall also include certification of installation, start-up (commissioning), and on-site training of Owner's staff.
- B. Testing, startup and training shall not be cause for claims for delay by the Contractor, and all expenses accruing therefrom shall be deemed to be incidental to the Contract.

1.02 RELATED WORK

- A. Other divisions requiring equipment testing and commissioning include, but are not limited to, the following:
 - 1. Division 8 - Doors and Windows (Motorized Overhead Doors)
 - 2. Division 21 - Fire Suppression
 - 3. Division 22 - Plumbing
 - 4. Division 23 – HVAC
 - 5. Division 26 – Electrical
 - 6. Division 33 – Utilities
 - 7. Division 40 - Process Interconnections
 - 8. Division 41 - Material Processing and Handling Equipment (Cranes and Hoists)
 - 9. Division 43 – Process Gas and Liquid Handling Storage and Equipment
 - 10. Division 46 - Water and Wastewater Equipment
- B. Section 01 33 00 – Submittal Procedures

1.03 SUBMITTALS

- A. Furnish submittals in accordance with Section 01 33 00, Submittal Procedures.
- B. Submittals include:

1. Commissioning Plan
 2. Commissioning Schedule
 3. Instrument and Control Valve Calibration Form
 4. Final Quality Control Reports as specified in the Technical Specifications.
 5. Certificate of Installation and Testing Forms
 6. Certificate of Training Forms
- C. Not less than thirty (60) days before anticipated time for beginning the testing of the facility, the Contractor shall submit to the Engineer for approval:
1. Commissioning Schedule including:
 - a. Dates for final quality control tests.
 - b. Dates for equipment manufacturer on-site installation inspections.
 - c. Dates for motor testing.
 - d. Dates for field instrument and valve calibration testing.
 - e. Dates for control panel I/O testing.
 - f. Dates that plant control system programming will be required for testing.
 - g. Dates that water or sewage will be required for testing.
 - h. Dates for equipment manufacturer on-site functional testing
 - i. Dates for operator training.
 2. Commissioning Plan for each new or modified unit process shall include detailed procedures and start-up requirements (water, power, chemicals, etc.) for:
 - a. New fine screen and associated isolation gates
 - b. Clarifier mechanisms and clarifier level control system
 - c. UV Disinfection System and isolation valves
 - d. Centrifuge and Dewatering System Polymer make-down
 - e. Motor Control Center and VFDs
 - f. Filter Feed Lift Station and forcemain

- g. Clarifier Effluent and Filter Effluent return new valving.
- h. Utility water air-gap and booster pump system
- i. Tertiary Treatment Chemical Feed Systems and Storage Tanks
- j. Flash Mixing, Coagulation and Flocculation Tanks and System
- k. Tertiary Automatic Backwashing Disk Filters
- l. Plant Drain Pump System Discharge Forcemain new connections
- m. Building Heating and Ventilation Systems

2.00 PRODUCTS

2.01 FUEL AND LUBRICANTS

- A. All oil, lubricants, and grease as specified by the manufacturer for each piece of equipment furnished by the contractor will be furnished by the Contractor. Lubricants shall be of one brand (to the greatest extent practicable), acceptable to the Owner. The Contractor will refill all fuel tanks upon acceptance of the work by the Owner, to replace any fuel used during testing and commissioning, except as otherwise agreed to in writing during the testing submittal phase.
- B. The Contractor shall make a maintenance chart on 8½"x11" sheets on which shall be shown, in a list, each item of equipment requiring lubricant, the type and quantity of lubricant required, the frequency of lubrication required, and a space for the last date that each piece of equipment was lubricated.
- C. The Contractor shall provide a one year's supply of every kind of packing grease or oil required for new equipment.
- D. Furnish all oil cans, grease guns and all other necessary items for proper lubrication.
- E. Lubrication charts shall be included in the maintenance manual for each piece of equipment.
- F. Costs for the above shall be considered incidental to the bid.

3.00 EXECUTION

3.01 GENERAL

- A. Testing shall consist of individual tests and checks made on equipment intended to provide proof of performance of units and proper operation of unit controls.

- B. Tests are to assure proper alignment, size, condition, capability, strength, adjustment, lubrication, pressure, flow, leakage and any other checks deemed necessary by the Engineer to determine that all materials and equipment are of specified quality, properly situated, anchored and in all respects ready for use.
- C. Contractor shall provide temporary valves, gauges, piping, test equipment and other materials and equipment required for testing and startup.
- D. Tests on individual items of equipment, pipelines, vessels, structures, tanks, controls and other items shall be as described in their respective specification sections.
- E. Testing will be done by the Contractor in the presence of the Resident Project Representative (RPR). Records of all official tests will be signed by the RPR or the Engineer.
- F. During tests, the Contractor shall correct any defective work that fails to comply with parameters described in the technical specifications.

3.02 PREPARATION

- A. Prior to manufacture's inspection and field testing of equipment and systems, Contractor shall at minimum check the following, as applicable:
 - 1. Supports anchored.
 - 2. Equipment and associated piping plumbed and leak tested and test form submitted.
 - 3. Process basins and hydraulic gates leak tested and test form submitted.
 - 4. Process basins, tanks, and piping cleaned and flushed.
 - 5. Valves and gates open and close as required.
 - 6. Shaft properly aligned.
 - 7. Equipment lubricated in accordance with manufacturer's instructions.
 - 8. Equipment and motor rotate in proper direction.
 - 9. V-belt tension adequate.
 - 10. Guards in place.
 - 11. Emergency switches and pull cords in place.
 - 12. Power supply cables connected.

13. Power supply voltage and phase correct.
14. Instrumentation installed properly and control wiring terminated.
15. Instrument Calibration Forms submitted.
16. I-O Checkout Form submitted.
17. Equipment is properly tagged.
18. All associated equipment and spare parts on-site.

3.03 MANUFACTURER’S INSTALLATION INSPECTION AND TESTING

- A. Contractor shall provide an authorized factory-trained Manufacturer’s Representative to inspect the installation to verify that the installation is in accordance with Manufacturer’s instructions and is in compliance with plans, specifications, and approved manufacturer submittals.
- B. Manufacturer’s Representative shall be experienced and knowledgeable in the equipment being tested.
- C. Contractor shall notify the RPR and the Engineer a minimum of ten (10) working days in advance of running any tests, unless otherwise specified, and no tests shall be accepted unless the RPR is present.
- D. Manufacturer’s Representative will adjust and test the equipment before the acceptance of the work by the Owner.
- E. Manufacturer’s Representative shall assist and instruct the operating staff in adjusting and operating the equipment during inspection and testing.
- F. Manufacturer’s Representative shall provide Certification of Installation and Testing Form to the Engineer that equipment is properly installed and field tested. Refer to the forms at the end of this Section.

3.04 ON-SITE TESTING

- A. Tests shall demonstrate to the Engineer that all equipment operates properly and specified performance has been attained.
- B. Should test indicate unsatisfactory operation, conditions shall be corrected and test repeated at Contractor's expense.
- C. Equipment shall be performance tested in place with its own motor. The tests shall duplicate all operating modes and failure modes.
- D. For pumps:

1. Include measurement of suction and discharge pressure at the pump and measurement of pumping rate by volumetric means or through a suitably calibrated meter for two points on the performance curve.
 2. For adjustable-speed pumps, conduct tests at a minimum of two speeds.
 3. Furnish any test equipment or measuring devices required, which are not part of the permanent installation.
 4. Submersible pump installations shall be checked before the pumps are submerged or the wet wells are filled.
 5. Vibration: Centrifugal pumps shall not exceed the acceptable vibration limits in accordance with the Hydraulic Institute Standards.
- E. Each piece of equipment, for which certified witnessed or non-witnessed performance tests are required, shall be accompanied by a completed Equipment Record Form and a completed Manufacturer's Certification Installation Form containing at least the following information:
1. Owner's name and location of project.
 2. Contractor's name and subcontractor(s) or lower tier supplier(s) if applicable.
 3. Name of item being submitted.
 4. Specification reference by section, paragraph and page.
 5. Data on item (manufacturer, general descriptive data, dimensions, size of connections, speeds, performance curves, serial number). A specific list of the test results plus a list, which shows the values that differ from Specifications.
 6. Motor data, type, voltage, frequency, phase, full load amperes, starting method, frame size, enclosure insulation type (NEMA Code letter), dimensions, service factor, serial number.
 7. Date and signature of person certifying the performance.

3.05 STARTUP

- A. Startup shall consist of testing by a simulated operation, all operational equipment and controls. The purpose of these tests shall be to check that all equipment will function under operating conditions, that all inter-locking controls and sequences are properly set and that the facility will function as an operating unit.
- B. The startup shall not begin until all tests required by these Specifications have been completed and approved by the Engineer.

- C. The Contractor may, if approved by the Engineer, conduct the hydraulic testing of pumps, aerators and other equipment requiring large volumes of liquid simultaneously with the startup test. If required by the Owner, the Contractor shall dispose of the water used by pumping to waste.

3.06 OPERATION

- A. Operation of the facility shall be immediately started after completion of testing and startup and after satisfactory repairs and adjustments have been made and providing supply and disposal facilities furnished by others are available. If these facilities are not available, the plant system will be closed down and no further testing or operation by the Contractor will be required. The Contractor, however, will be responsible that all details required by the Contract shall remain in good order until final acceptance of the whole Contract.
- B. The facility will be operated by personnel placed on the project by the Owner who will perform all duties and operate all equipment.
- C. Taking possession and use of the facility or portions of the facility, shall not be deemed an acceptance of any work not completed in accordance with the Contract Documents.
- D. If such prior use increases or causes refinishing of completed work, the Contractor shall be entitled to such extra compensation or extension of time or both, as the Engineer may recommend, but the Owner shall determine.

3.07 INSTRUCTION OF OWNER'S PERSONNEL

- A. During the pre-startup checkout and the functional testing period, the Contractor shall provide for instruction of the Owner's personnel in the operation and maintenance of the facility. Instruction shall be performed by factory-trained engineers and technicians, knowledgeable in the operation of the various types of equipment. In addition to this instruction, contractor shall provide additional operator instruction and operation assistance as required in the various sections of the Specifications.
- B. Where the individual sections of the Specifications require visits to the site for manufacturer's representatives for the purpose of instructing the Owner's personnel in operation and maintenance of various equipment items or systems, this shall be deemed to be a separate visit to the site, independent of visits required for equipment checkout, testing, and startup unless prior approval of the Engineer is received.
- C. Because of its importance to the Owner, Contractor must schedule in writing with the Owner at least 15 days in advance any visits to the site by manufacturers' representatives for the purpose of fulfilling their operation and maintenance instruction requirements. The person or persons the Contractor proposes to perform the training shall be identified and their qualifications to perform this training shall be submitted for approval.

- D. This scheduling shall be subject to approval by the Owner and Engineer. Contractor should generally plan, unless otherwise required in an individual section of the specifications, to schedule training sessions so they occur after the system has started normal operation.
- E. Manufacturer's qualified service technician shall provide training of the Owner's staff for operation and maintenance of the equipment specified and furnished for this project, particularly process equipment specified in divisions 40, 43, and 46. Additional training or instruction recommended by the manufacturer shall be provided at no additional cost to the Owner. Unless otherwise specified, a minimum of eight (8) hours of training shall be provided for each specified equipment type and each specification section. Minimum requirements are listed below.
1. Identification of equipment parts and features.
 2. Safety instruction.
 3. Description of normal operating procedures, including instruction on where to reference normal procedures in the operation and maintenance manual.
 4. Equipment disassembly demonstration.
 5. Instruction on normal preventative maintenance procedures, including clearance checking and adjusting, lubrication and lubrication schedule, repair or replacement of parts as applicable.
 6. Instruction on troubleshooting procedures.
 7. Overview of corrective maintenance procedures.

*** END OF SECTION ***

1.00 GENERAL

Project closeout activities and submittals as specified shall be satisfactorily completed by the Contractor prior to final project acceptance and release of final payment and retainage.

1.01 FINAL CLEANUP:

- A. The Contractor shall promptly remove from the vicinity of the completed work all rubbish, unused materials, concrete forms, construction equipment, and temporary structures and facilities used during construction. Final acceptance of the work by the Owner will be withheld until the Contractor has satisfactorily complied with the foregoing requirements for final cleanup of the project site.
- B. Clean each surface or unit to the condition expected in a normal, industrial building cleaning and maintenance program. Use only cleaning materials and methods recommended by manufacturer on surfaces to be cleaned.
- C. Leave entire project perfectly clean and ready for occupancy. All building and fixture surfaces shall be turned over to the Owner in a new condition, free from all damage, dust, dirt, spots, stains, encrustations, and other blemishes. In the event of untimely final cleaning, Engineer may require as he determines appropriate re-cleaning, which will be performed at no added cost to Owner.
- D. Clean-up shall include:
 - 1. Vacuum entire interior of project.
 - 2. Clean all air ducts and ventilation equipment.
 - 3. Hand dust and clean shelves and cabinets.
 - 4. Remove labels that are not permanent.
 - 5. Clean exposed exterior and interior hard-surfaced finishes to a dust-free condition, free of all stains, films, and similar foreign substances.
 - 6. Clean finish floors and floor coverings; wax when specified.
 - 7. Leave concrete floors broom clean.
 - 8. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compound and other substances that are noticeable vision obscuring materials. Replace chipped or broken glass and other damaged transparent materials.
 - 9. Restore reflective surfaces to their original reflective condition.
 - 10. Remove all protective coverings from all accessories furnished or installed.
 - 11. Wipe surfaces of mechanical and electrical equipment. Remove excess lubrication and other

substances. Clean plumbing fixtures to a sanitary condition. Clean light fixtures and lamps.

12. Clean the site, including landscaped areas, of rubbish, litter, and other foreign substances. Sweep paved areas broom clean; remove stains, spills, and other foreign deposits. Rake grounds that are neither paved nor planted to a smooth, even-textured surface. Properly dispose of waste materials off-site.
- E. Contractor shall continue final cleanup as may be required by the punch list or other corrective work until such work is complete.
- F. Remove temporary protection and facilities installed for protection of the work during construction.
- G. Organize and label all spare parts along shelving, to be provided by the Contractor, in the Preliminary Treatment and Maintenance Buildings. Contractor to provide a master list of all spare parts to the Owner.
- H. Compliance:
1. Comply with regulations of authorities having jurisdiction and safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on the Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage system or waterways. Remove waste materials from site and dispose of in a lawful manner.
 2. Where extra materials of value remaining after completion of associated work have become the Owner's property, arrange for disposition of these materials as directed.

1.02 CLOSEOUT TIMETABLE:

The Contractor shall establish dates for equipment testing, acceptance periods, and on-site instructional periods (as required under the Contract). Such dates shall be established not less than one (1) week prior to beginning any of the foregoing items, to allow the Owner, the Engineer, and their authorized representatives sufficient time to schedule attendance at such activities.

1.03 FINAL SUBMITTALS:

Prior to requesting final payment, the Contractor shall obtain and submit the following items to the Engineer for transmittal to the Owner:

1. Written guarantees, where required.
2. Operating manuals and instructions.
3. Keying schedule.
4. Maintenance stock items, spare parts, and special tools.
5. Any of the above information/documents on computer disk, as requested by Owner.
6. Completed Record Drawings.

7. Bonds for roofing, maintenance, etc., as required.
8. Certificates of inspection and acceptance by local governing agencies having jurisdiction.
9. Release from all parties who are entitled to claims against the subject project, property or improvement pursuant to the provisions of law.
10. Other required items.

1.04 MAINTENANCE AND WARRANTY:

- A. The Contractor shall comply with the warranty requirements of these Contract Documents. See Section 01 78 36 and technical specifications.
- B. Replacement of earth fill or backfill where it has settled below the required finish elevations, shall be considered as a part of such required repair work, and any repair or resurfacing constructed by the Contractor that becomes necessary by reason of such settlement shall likewise be considered as a part of such required repair work, unless the Contractor shall have obtained a statement in writing from the affected private owner or public agency releasing the Owner from further responsibility in connection with such repair or resurfacing.
- C. The Contractor shall make all repairs and replacements promptly upon receipt of written order from the Owner. If the Contractor fails to make such repairs or replacements promptly, the Owner reserves the right to do the work and the Contractor and surety shall be liable to the Owner for the cost thereof.

1.05 SUMMARY OF CONTRACT CLOSEOUT ACTIVITIES:

- A. This sub-section specifies administrative and procedural requirements for project closeout. These procedures shall be coordinated with and through the Engineer. Work includes the following. See other specification sections for specific requirements.
 1. Substantial completion and punch list procedures
 2. Record drawings
 3. Operating and maintenance instructions
 4. Operation and maintenance manuals
 5. Warranty manual
 6. Warranty list items
 7. Final cleanup
 8. Final acceptance

1.06 RELEASE OF RETAINAGE:

Prior to the release of retainage, the Owner shall have received:

1. Documentation from the Washington State Department of Revenue that sales tax has been paid by the Contractor.

2. Documentation provided by the Contractor that all worker's compensation and medical insurance premiums have been paid, including the account number. Verification may be in the form of a Washington State Department of Labor and Industries Employer Liability Certificate showing the State account number and that the account is current (for Prime and all Subcontractors).
3. Affidavit of release of liens and lien releases, and other as indicated in the General Conditions.

****END OF SECTION****

1.00 GENERAL

1.01 DESCRIPTION:

A. Requirements

1. The Contractor shall warranty all materials and equipment furnished and work performed for a period of one (1) year from the date of Substantial Completion of the entire Project, unless longer periods are specified elsewhere in these Contract Documents. See paragraph 1.04 of this section for equipment manufacturer's warranty requirements. For the purposes of establishing the warranty period for both the Contractor's warranty and equipment manufacturer warranties, the term "Substantial Completion" in the General Conditions shall apply to the entire project, not a part or parts thereof.
2. Additional requirements for warranties may be included in individual specification sections. See General Conditions and paragraph 1.03 of this section for warranty requirements and obligations.
3. Neither the final certificate of payment, any provision in the Contract, nor partial or entire use of occupancy by the Owner shall constitute an acceptance of work not done in accordance with the Contract, or relieve the Contractor of liability in respect to any warranties or responsibilities for faulty materials and workmanship.

B. Definitions

1. "Guarantee" "Warranty" and "Correction Period" are used interchangeably and are understood to mean the same thing. See General Conditions for definition.
2. "Standard product warranties" are pre-printed written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner.
3. "Special warranties" are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the Owner.

C. Types

Categories of warranties required for the work and specified in these Contract Documents include:

1. Special project warranty ("Contractor's Warranty", attached) issued by Contractor and, where applicable, countersigned by a Subcontractor, installer, or other recognized entity involved in performance of the work ("Subcontractor's Warranty", attached).
2. Specified product warranty issued by a manufacturer or fabricator for compliance with requirements in Contract Documents.
3. Coincidental product warranty, available on a product incorporated into the work, by virtue of manufacturer's publication warranty without regard for application requirements (non-specified warranty.)

4. Refer to individual sections of specifications for requirements of specified warranties.

D. Disclaimers and Limitations

Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the work that incorporates the product, nor does it relieve suppliers, manufacturers, or subcontractors required to countersign special warranties with the Contractor.

1.02 SUBMITTALS:

A. General

Prepare per General Conditions and Section 01 33 00 - Submittals, and as follows.

1. The Contractor's written special project warranty shall be submitted to the Engineer on the "Contractor's Warranty" form attached to this Section, or in a similar format.
2. For subcontractor warranties, as specified, a warranty by each such subcontractor, countersigned by the General Contractor, shall be submitted to the Engineer on the "Subcontractor Warranty" form attached to this Section, or in a similar format.
3. The Contractor shall be responsible for obtaining manufacturer warranties.
4. Other warranties shall be as specified in individual specification sections.

B. Format

1. Bind each warranty manual in a three-ring, heavy-duty, vinyl, hard cover binder.
2. On the cover, imprint title "Warranty Manual". Include name of project, Owner, Engineer, and date of Substantial Completion.
3. On the bound edge, imprint name of project and Owner and date of Substantial Completion.
4. Pages to be neat, clean sheets, 8-1/2" x 11" maximum size, or accordion foldouts to same size.
5. Items to be identified with tabbed dividers showing name and number of appropriate specification sections.
6. Arrange dividers and items in order they occur in specifications.

C. Information Required

1. Table of Contents identifying separate warranties by specification section number and name.
2. Contractor's warranty of the work per contract requirements.

3. Warranties, certificates, and bonds for all portions of the work per individual sections of the specifications.
4. Certificate of occupancy obtained from the appropriate building officials.

D. Distribution

1. Submit one (1) preliminary copy to Engineer for review.
2. Upon review of preliminary copy, prepare and submit two (2) final copies to Engineer, one for the Engineer and one for the Owner.

1.03 WARRANTY OBLIGATIONS:

- A. See General Conditions.
- B. All equipment furnished shall bear a one (1) year (from date of substantial completion of the entire project) manufacturer's warranty against defects in materials and workmanship, in addition to the Contractor's one-year warranty, unless specified otherwise in these Specifications. All parts or equipment found defective or showing signs of undue wear within the warranty period shall be replaced at no cost to the Owner. The warranty shall be in full effect, with no qualifications or reservations or prorated periods.
- C. Restore or remove and -replace other work which has been damaged by defective warranted work, or which must be removed and replaced to gain access to warranted work.
- D. Cost of restoration or removal and replacement is the Contractor's obligation, without regard to whether Owner has already benefited from use of said defective work.

1.04 ONE YEAR CERTIFICATION:

A. Eleventh Month Inspection

The Owner and Engineer will conduct an eleventh-month inspection, which will result in a one-year certification as to proper operation and performance of the completed construction project. The Contractor will be invited to take part in this inspection.

B. Testing

The eleventh-month inspection may, at the Owner's discretion, include inspection, operation, and testing of systems, components, and equipment that were furnished and installed as a part of this construction project.

C. Correction

All items found to be in non-conformance with the design operation and performance requirements of these Contract Documents shall be corrected immediately by the Contractor, at the Contractor's sole expense. Any operation and performance problems found to be a result of improper use or operation by the Owner will be corrected at the Owner's expense.

1.05 OWNER'S RECOURSE:

Warranties and warranty periods do not diminish implied warranties and do not deprive Owner of actions, rights, and remedies otherwise available as a result of the Contractor's failure to fulfill requirements of the Contract documents. Owner reserves the right to reject coincidental product warranties considered to be conflicting with, or detracting from, requirements of the Contract Documents.

CONTRACTOR'S WARRANTY

Date: _____

General Contract Date: _____

Owner: _____

Address: _____

Project: _____

_____ (Contractor), the undersigned, warrants for a period of _____ year(s), as specified in Section 01 78 36 of the Contract Documents, from the date of Certificate of Substantial Completion, all work performed under the provisions of the Agreement between the Owner and Contractor.

_____ (Contractor) will remedy any defects appearing during the warranty period which are due to failure, faulty materials, poor workmanship, or other nonconformity with or omission from the contract documents.

The following subcontractors performed the work or furnished the materials subject to warranty:

Trade	Subcontractor	Address	Phone	Contact Person
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
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_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

This warranty does not include holding the Contractor responsible for defects caused by wear and tear under normal usage.

Contractor: _____

Address: _____

Phone: _____ Fax: _____

Contact Person: _____

Signature: _____
(authorized representative)

SUBCONTRACTOR'S WARRANTY

Date: _____

General Contract Date: _____

Owner: _____

Address: _____

Project: _____

The General Contractor, _____, and the Subcontractor, _____, warranty for a period of _____ year(s), as specified in Section 01 78 36 of the Contract Documents, all work performed under the provisions of the Agreement between the Owner and the Contractor. The undersigned will remedy any defects appearing during the warranty period which are due to failure, faulty materials, poor workmanship, or other nonconformity with or omission from the contract documents.

This warranty does not include holding the Contractor or Subcontractor responsible for defects caused by wear and tear under normal usage (per General Conditions).

Trade or Item(s): _____

Subcontractor: _____

Address: _____

Phone: _____ Fax: _____

Contact Person: _____

Signature: _____

(authorized representative)

Contractor: _____

Address: _____

Contact Person: _____

1.00 GENERAL

1.01 SEQUENCE AND LIMITATIONS OF CONSTRUCTION

A. General Criteria

The purposes of the sequence and limitations of construction are:

1. To comply with effluent quality limitations as ordered by the U.S. Environmental Protection Agency and NPDES Permit;
2. To maintain the highest possible level of treatment while removing treatment processes from service which have no standby units in order to complete necessary modifications, and while transitioning from existing processes or units to new ones;
3. To maintain the necessary minimum number of liquid and solid stream units in effect operation;
4. To be able to remove solids from the liquid stream processes and transport them as necessary to points of disposal;
5. To continuously maintain plant monitoring and control functions;
6. To assure the availability of electric power;
7. To assure the availability of miscellaneous support systems at all times during the completion of this Contract; and,
8. To insure that the Contractor understands the limitations placed on his work by the specified characteristics of the treatment facility.

The Contractor shall schedule and conduct his work in a manner consistent with achieving these purposes, and his construction schedule shall comply with the sequence and limitations of work hereinafter specified.

1.02 MAINTENANCE OF SERVICE

A. General

The existing Wastewater Treatment Facilities are currently and continuously receiving and treating wastewater, and those functions shall not be interrupted except as specified herein. The Contractor shall coordinate the work to avoid interference with normal operation of plant equipment and processes. See Section 01 90 00 for further requirements concerning coordination with operation of existing facilities.

B. Bypassing

Bypassing of untreated or partially treated wastewater to surface waters or drainage courses is prohibited during construction. In the event accidental bypassing is caused by the Contractor's operations, the

Owner shall immediately be entitled to employ others to stop the bypassing and charge the Contractor for this cost, either directly or to withhold it from the next partial payment. Penalties or other costs imposed on the Owner as a result of any bypass caused by the actions of the Contractor, his employees or subcontractors, shall be borne in full by the Contractor, including legal fees and other expenses to the Owner resulting directly or indirectly from the bypass.

C. Violation of NPDES or Other Limits

The City of Leavenworth's Wastewater Treatment Plant discharge is regulated by NPDES Permit Number WA0020974. Violation of the effluent suspended solids, biochemical oxygen demand, pH, and chlorine residual, or other limits in the NPDES permit is prohibited at all times. In the event of violation due to the activities of the Contractor, the Owner shall immediately be entitled to employ others to stop the violation and charge the Contractor for this cost, either directly or to withhold it from the next partial payment. Penalties imposed on the Owner as a result of any violation of the Effluent Limitations caused by the actions of the Contractor, his employees, or subcontractors shall be borne in full by the Contractor, including legal fees and other expenses to the Owner resulting directly or indirectly from the order violation.

D. Submittal

In accordance with Section 01 33 00, the Contractor shall submit a detailed outage plan and time schedule for each operation which will make it necessary to remove a tank, pipeline, channel, electrical circuit, instrument loop, equipment, or structure from service. The number of outages shall be minimized through the use of isolation valves and terminal boxes. See Sections 01 50 00 and 01 90 00 regarding temporary facilities and equipment requirements. The schedule shall be coordinated with the construction schedule specified in Section 00 13 00 and Section 00 13 20 and shall meet the restrictions and conditions specified in this section. The detailed plan shall describe the Contractor's method for preventing bypassing of other treatment units, the length of time required for complete said operation, and the necessary plant and equipment which the Contractor shall provide in order to prevent bypassing of associated treatment units.

Systems or individual equipment items shall be isolated, dewatered, and decommissioned in accordance with the detailed schedule. The Engineer and Owner shall be notified in writing at least one (1) week in advance of any construction activities that may affect the existing treatment system including any planned outage in any area.

1.03 SEQUENCE OF CONSTRUCTION

The Contractor shall be solely responsible for sequencing all construction activities to meet the requirements of these Contract Documents and to maintain continuous wastewater treatment service meeting the effluent requirements outlined in the City's NPDES permit. All labor, equipment, materials, including temporary construction facilities, temporary treatment facilities, hauling and disposal of solids, bypass pumping, piping, electrical, etc. needed for construction sequencing/phasing and continuous operation of the treatment plant shall be included in the amount bid.

A detailed sequence of construction shall be included with the proposed construction schedule for review and approval; and shall include anticipated outages or a window where an outage is anticipated to be necessary for owner review and approval. See Section 01 32 00 and General Conditions for construction

SEQUENCE AND LIMITATIONS OF CONSTRUCTION

Section 01 89 00 – Page 3

schedule requirements. Proposed changes to the construction sequencing must be reviewed and approved by the Engineer prior to the changes being incorporated into the construction schedule.

Tasks which specifically require coordination with the treatment operator shall be clearly indicated on the proposed construction schedule.

****END OF SECTION****

1.00 GENERAL

1.01 DESCRIPTION

The existing wastewater treatment facilities will be in operation throughout the execution of this Contract. The Contractor shall therefore schedule and conduct his work so as to minimize interference with plant operation and maintenance. It is the intent and requirement of this Contract that construction activities shall not interfere with the proper operation of the plant.

The Contractor is responsible for familiarizing himself with the details of the existing treatment facilities and their operation as required for him to properly plan and implement all activities related to this work in such a manner that the requirements of these specifications are met.

1.02 COORDINATION, WEEKLY MEETINGS REQUIRED

The Contractor shall coordinate closely with the plant operators and the Engineer to assure that the requirements of this Section and Section 01 89 00 are met at all times. In addition, weekly plant operation coordination meetings shall be held between the Contractor, the Engineer and City plant operators, during which the Contractor shall describe to all parties all of his upcoming proposed activities which may impact any plant operation or maintenance, including any planned temporary system or facilities. The Contractor shall respond promptly to resolve concerns and problems observed and voiced by the plant operators and the Engineer.

1.03 OPERATION OF EXISTING TREATMENT FACILITIES

The Owner's operating personnel will be responsible for operating and maintaining the existing treatment facilities, except as may be affected by 1.04 below. Equipment presently installed in the treatment plant must be available to plant personnel at all times for use, maintenance and repair. If it is necessary in the course of operating the plant for the Contractor to move his equipment, materials or any material included in the work, he shall do so promptly and place such equipment or material in an area which does not interfere with the plant operation. The Contractor shall not adjust, operate or interfere with serviceable or properly functioning of existing equipment or systems, except as may be affected by 1.04 below.

Contractor's coordination with operations of existing facilities shall include:

1. Temporary facility's and systems
2. Maintaining integrity of existing plant utilities at all times.
3. Maintaining 2 clarifiers in service at all times.
4. Ensuring aeration basin aerators are not offline for more than 4 hours.
5. Maintaining access road as required for plant operations is maintained at all times, including access to the sludge dewatering building for City's sludge hauling truck, for approximately 3 trips per week.
6. Dewatering system (existing and temporary) shall not be offline expect as approved and coordinated with the City; and shall not be offline for than 1 day at a time except during initial setup of the temporary biosolids system which shall not exceed a period of 1 week and shall be completed only during the months of April, May or June.

1.04 CONTRACTOR TEMPORARY TREATMENT SYSTEMS AND FACILITIES

A. General

The Contractor shall be solely responsible for selecting, designing, furnishing, installing, operating, monitoring, and maintaining adequate, reliable and safe temporary piping, pumping, power and control

facilities, and any other temporary system, structure or appurtenance, as required to maintain continuous plant operation and complete treatment as specified through-out the construction period.

B. Temporary Systems and Facilities

Temporary systems and facilities shall include, but are not limited to, the following:

1. Temporary piping / valving system(s);
2. Bypass pumping system(s);
3. Temporary Electrical system(s)
4. Temporary solids dewatering and/or disposal (Schedule B) including:
 - a. Temporary solids dewatering system and facility adjacent to existing dewatering building. Temporary facility to utilize existing belt filter press and include all items necessary for a complete and fully functional temporary dewatering system/facility including belt filter press, piping, appurtenances, electrical, weather enclosure, heating, etc. Temporary system shall discharge dewatered solids into the existing City truck for hauling and disposal.
 - b. Hauling and disposal of solids not dewatered by the temporary dewatering facility as needed to maintain the treatment process until the new facility is online.
5. Temporary UV disinfection facility (Schedule A) including:
 - a. Temporary UV disinfection system and facility adjacent to existing UV building. Temporary facility to utilize new UV disinfection equipment and shall include all items necessary for a complete and fully functional temporary disinfection system including piping, appurtenances, electrical, weather enclosure, heating, etc.
 - b. Temporary UV system may either be constructed below grade for gravity flow to the outfall or may utilize the filter feed pump station at the Contractor's option. All alterations and/or modifications to the filter feed pump station shall be removed and the filter feed pump station constructed in accordance with the plans/specifications once the new UV system is online.

B. Submittal Required

The Contractor shall prepare and submit for Engineer and Owner review specific information regarding planned temporary systems and facilities adequately in advance of their installation and use, for the purpose of Owner scheduling of affected operations and Owner review for compatibility with plant operation. Such submittal shall be detailed enough to communicate the location, size, capacity, configuration and operation of all temporary systems and facilities, as well as adequate provision for back-up systems or plans to assure their reliable operation.

1.05 SWITCH-OVER TO NEW FACILITIES

COORDINATION WITH OPERATION OF EXISTING FACILITIES

Section 01 90 00 – Page 3

Planning, scheduling and implementation of switch-over to new facilities constructed under this contract shall be the sole responsibility of the Contractor, shall assure continuous and adequate treatment as specified in this Section and Sections 01 01 00 and 01 89 00, and shall be fully coordinated with City operating personnel and the Engineer. No new facility or item shall be put into service until completed and successfully tested as specified elsewhere in these Contract Documents.

****END OF SECTION****

1.00 GENERAL

1.01 DESCRIPTION OF WORK:

Work covered by this section consists of furnishing and installing all formwork, embedded items and form ties for cast-in-place concrete to produce the finished concrete elements as shown on the drawings.

1.02 GENERAL REQUIREMENTS:

All formwork and methods of construction shall conform to the requirements of the Department of Labor and Industry of the State of Washington and OSHA Standards.

1.03 REFERENCE STANDARDS:

A. American Concrete Institute (ACI):

ACI 301 - Specifications for Structural Concrete for Buildings

B. American Society for Testing and Materials (ASTM):

A 153 - Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware

1.04 SUBMITTALS:

When requested by the Engineer for the purposes of explaining detail or structural integrity, the Contractor shall submit formwork shop drawings in accordance with Section 01 33 00 of the specifications. Complete descriptive literature shall be submitted for items proposed as alternatives to products specified.

2.00 PRODUCTS

2.01 GENERAL:

A. The Contractor shall provide all formwork and those materials required to develop the strength and finishes required of the finished concrete.

B. Except where noted herein, the formwork system used is the Contractor's choice, provided it performs in the manner specified.

1. Form materials:

Contractor may use any forming materials and methods which will achieve the finish qualities specified in Section 03 33 00, subject to the following limitations.

2. Form coatings:

Provide commercial formulation form-coating compounds that will not bond with, stain or adversely affect concrete surfaces, and will not impair subsequent treatments of concrete

surfaces requiring bond or adhesion or impeded wetting of surfaces to be cured with water or curing compound.

3. Form ties:

Form ties shall be bolts or rods designed so that no metal shall be within the required thickness of reinforcement cover of the finished concrete surface, and to provide a void which shall be grouted to seal the opening. The detail used shall be watertight for all exterior concrete and concrete in contact with earth or water.

2.02 EMBEDDED ITEMS:

A. See Section 05 50 00, Miscellaneous Metals for Anchor bolts.

B. Inserts shall be as required by other trades or as shown on the drawings. Attach securely to forms. Inserts within reinforcement cover thickness shall be hot-dip galvanized, nonferrous or other approved non-rusting material.

C. Waterstops:

See Section 03 33 00, paragraphs: Waterstops and Construction Joints. Splice to maintain continuity at corners and intersections.

D. Embedded Conduit:

Rigid embedded conduit shall be of hot-dip galvanized steel or plastic specified elsewhere. Conduit shall be approved and listed by Underwriters Laboratories, Inc. and bear the UL label.

E. Miscellaneous Embedded Items:

All exposed items permanently embedded in concrete within the required concrete reinforcement cover thickness shall be hot-dip galvanized, nonferrous or plastic as approved, to eliminate the possibility of stained or rusty spots.

3.00 EXECUTION

3.01 FORM DESIGN:

Forms shall be designed on the basis of deflection to maintain true lines within the allowable variations indicated in 3.02 A. 1 herein. Slab, beam and girder forms shall be cambered for dead load. Forms shall be braced and supported as required.

3.02 FINISH CONCRETE TOLERANCES:

A. Every reasonable effort shall be made to maintain plumbness, and alignment as shown on the drawings.

1. Allowable variations - maximum

- a. Tops of walls, parapets and curbs exposed to visual alignment + 1/8 inch in 10 feet.
- b. Cross-section thicknesses of walls, columns and beams + 1/8 inch.
- c. Flat surfaces of walls, slabs and tank sides, + 1/8 inch in 10 feet.
- d. Linear alignment of structure lines, tank sides, and column lines as follows:
 - i. 10-foot length - 1/8-inch
 - ii. 20-foot length - 3/8-inch
 - iii. 40-foot length - 1/2-inch
 - iv. Over 40 feet - 3/4-inch
- e. Footings:
 - i. Alignment: + 2 inches
 - ii. Thickness: Plus-as required. Minus-none.

3.03 CONSTRUCTION DETAILS:

A. Exposed edges of concrete on the outside of structures and all those in the inside of structures shall be chamfered or beveled at an angle of 45°, such bevel being 3/4-inch on a side, except where rounded corners are shown on the drawings. If so directed by the Engineer, however, the Contractor shall provide square edges for any portion of the work.

B. Form tie Holes:

Form tie holes shall be pointed-up fully with mortar as specified in Section 03 33 00.

C. Embedded Items:

1. Position in forms in location shown. Do not place concrete before receiving approval of placing plan.
2. Provide adequate support to prevent displacement during concreting.
3. Allow other trades ample time and facilities for placing and installing embedded items.
4. Conduits must have same cover as required for reinforcing. Do not embed conduits larger than 1-inch nominal size unless specifically called out on the drawings or written approval of Engineer is obtained. Conduits shall be placed inside the reinforcing.
5. No insert shall be permitted with less cover than the reinforcement unless approval of Engineer is obtained.

3.04 FORM CLEANING:

- A. All dirt, chips, sawdust, and other foreign matter shall be removed from within the forms before any concrete is deposited therein. Forms previously used shall be thoroughly cleaned of all dirt, mortar and foreign matter before being used.
- B. Temporary openings shall be provided at the base of column and wall forms and at other points where necessary to facilitate cleaning and inspection immediately before depositing concrete.

3.05 FORM REMOVAL:

- A. Form bracing and shores shall be kept in place until concrete has reached adequate strength to properly support itself. In no case shall removal commence earlier than the following schedule unless approved by the Engineer.

1. Sides of footings	24 hours
2. Walls and columns not yet supporting load	48 hours
3. Vertical sides of beams, girders and similar members	48 hours
4. Slabs, beams and girders	10 days
5. Shoring for slabs, beams and girders	21 days and after concrete has achieved specified minimum compressive strength.

- B. Forms shall not be stripped from concrete which has been placed at a temperature under 50 degrees F without first determining if the concrete has properly set, without regard to the time element. If, in the opinion of the Engineer, stripping of forms on the basis of above schedule would result in damage to the concrete, the schedule shall be modified to prevent such an occurrence.

4.00 MEASUREMENT AND PAYMENT

4.01 GENERAL:

- A. See Section 01 22 00 – Measurement and Payment for General Requirements. See Section 01 01 00 – Special Requirements/Bid Items for possible modifications to Standard Bid Items.
- B. If no specific bid item is provided, measurement and payment shall be considered incidental and shall be included in the bid price for other items of work for the project.

4.02 BID ITEMS:

Special provisions, requirements, revisions to these Bid Items, and/or additional Bid Items, may be included in Section 01 01 00 (green pages) or on the Drawings or Details.

****END OF SECTION****

1.00 GENERAL

1.01 DESCRIPTION:

- A. The work included in this Section consists of the construction of all structures, or parts of structures, composed of cast-in-place portland cement concrete, with or without reinforcement.
- B. Special provisions, requirements and/or revisions to this Specification and/or Bid Item(s) may be included in Section 01 01 00 (green pages) and/or on the Drawings or Details.

1.02 QUALITY ASSURANCE:

Provide at least one person who shall be present at all times during execution of this work and who shall be thoroughly familiar with forming, reinforcement and concrete placing, the referenced standards, and the requirements of this work, and who shall direct all work performed under this Section. The Contractor shall have on hand at all times a copy of the ACI Field Reference Manual, Publication SP-15, latest edition. For finishing of exposed surfaces of the concrete, use only thoroughly trained and experienced concrete finishers.

1.03 APPLICABLE STANDARDS:

- A. The provisions of the current edition of following publications form a part of these specifications. Where such provisions conflict with the requirements of these Contract Documents, the more stringent shall apply.

1. Concrete Reinforcing Steel Institute (CRSI)

- a. Manual of Standard Practice
- b. Placing Reinforcing Bars

2. American Concrete Institute (ACI)

- a. ACI 211 Recommended Practice for Selecting Proportions for Normal and Heavyweight Concrete
- b. ACI 212 Guide for use of Admixtures in Concrete
- c. ACI 301 Specifications for Structural Concrete for Buildings
- d. ACI 304 Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete
- e. ACI 304.2 Placing Concrete by Pumping Methods
- f. ACI 305 Hot Weather Concreting
- g. ACI 306 Cold Weather Concreting
- h. ACI 308 Standard Practice for Curing Concrete

- i. ACI 309 Standard Practice for Consolidating Concrete
 - j. ACI 315 Manual of Standard Practice for Detailing Reinforced Concrete Structures
 - k. ACI 318 Building Code Requirements for Reinforced Concrete
 - l. ACI 347 Recommended Practices for Concrete Form Work
 - m. ACI 350 Concrete Sanitary Engineering Structures
 - n. ACI 504 R (Waterstops)
3. American Society of Testing and Materials (ASTM)
- a. ASTM A-184 Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement
 - b. ASTM A-185 Specification for Welded Steel Wire Fabric for Concrete Reinforcement
 - c. ASTM A-615 Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
 - d. ASTM C-31 Method of Making and Curing concrete Test Specimens in the Field
 - e. ASTM C-33 Specification for Concrete Aggregates
 - f. ASTM C-39 Test Method for Compressive Strength of Cylindrical Concrete Specimens
 - g. ASTM C-42 Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
 - h. ASTM C-94 Specification for Ready-Mixed Concrete
 - i. ASTM C-109 Test Methods for Compressive Strength of Hydraulic Cement Mortars
 - j. ASTM C-143 Test Method for Slump of Portland Cement Concrete
 - k. ASTM C-150 Specification for Portland Cement
 - l. ASTM C-171 Specification for Sheet Material for Curing Concrete
 - m. ASTM C-172 Method of Sampling Freshly Mixed Concrete

- n. ASTM C-192 Method of Making and Curing Concrete Test Specimens in the Laboratory
 - o. ASTM C-231 Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
 - p. ASTM C-260 Specification for Air-Entraining Admixtures for Concrete
 - q. ASTM C-309 Specifications for Liquid Membrane-Forming Compounds for Curing Concrete
 - r. ASTM C-494 Specification for Chemical Admixture for Concrete
 - s. ASTM C-618 Specification for Fly Ash and Raw or Calcined Natural Pozzolan for use as a Mineral Admixture in Portland Cement Concrete
4. U.S. Army Corps of Engineers
- CRS C-572 Vinyl Water Stops

1.04 SUBMITTALS:

- A. Submittals shall conform to Section 01 33 00 of these Specifications.
- B. The Contractor shall submit Shop Drawings to the Engineer for review at the earliest possible time following the award of Contract, and shall include placement drawings and a schedule of reinforcing steel showing all pertinent dimensions, and all proposed construction joints, if any.
- C. Reinforcing steel shall not be delivered to the project site until Shop Drawings have been returned to the Contractor stamped “No Exceptions Taken” or with comments and no re-submittal required.
- D. Strength test results shall be submitted, by the laboratory, to the Engineer and Contractor immediately following the testing of the cylinders.

1.05 PRODUCT HANDLING:

A. Reinforcement Protection

Use all means necessary to protect concrete reinforcement before, during, and after installation and to protect the installed work and materials of all other trades. Store in a manner to prevent excessive rusting and fouling with dirt, grease, and other bond-breaking coatings. Use all necessary precautions to maintain identification after bundles are broken.

B. Concrete Protection

Use all means necessary to protect cast-in-place concrete materials before, during, and after installation and to protect the installed work and materials of other trades.

C. Replacements

In the event of damage, immediately make all repairs and replacements necessary to the approval of the Engineer and at no additional cost to the Owner.

2.00 PRODUCTS

2.01 FORMING MATERIALS:

A. All forming materials shall comply with ACI 347.

B. Wood

All wood, except for chamfer strips, shall be Douglas Fir or Larch, Construction Grade or better, as specified by Western Wood Products Association; all woods shall be grade marked. Chamfer strips shall be No. 1 Appearance Grade.

C. Plywood

All plywood shall be APA Plyform Class I, B-B Exterior Grade plywood; each panel shall have APA grade shown.

D. Ties

Form ties for wood forms shall have waterstops and shall be of the “snap-off breakback” type with conical-or spherical-type inserts at least 1-1/2” in depth and 1” in diameter. Flat bar ties used with steel form panels shall have plastic or rubber inserts to form a hole at least 1” deep for patching. Through bolts shall be tapered for ease of removal and patching. See 3.02 C. for form ties for sanitary structures.

E. Form Coating or Release Agents

Agents used on formed surfaces to be in contact with potable water shall be suitable for such use.

F. Curing Materials

Curing materials shall conform to ASTM C-309 (liquid membranes) and C-171 (sheeting materials). Curing compounds used on the interior of structures in contact with potable water shall contain no constituents that will impart taste or odor, and shall be certified as suitable for this use in accordance with state and federal requirements.

2.02 REINFORCING MATERIALS:

A. Reinforcing Steel Bars

Bars shall conform to ASTM A-615, Grade 40 or 60, as shown on the Plan Drawings. Unless shown otherwise, No. 3 and smaller bars shall be Grade 40 and No. 4 and larger bars shall be Grade 60.

B. Welded Wire Fabric and Bar Mats

Wire shall conform to ASTM A-82, and fabric shall conform to ASTM A-185. Bar and Rod Mats shall conform to STM A-184.

C. Bar Supports

Supports shall conform to CRSI Manual of Standard Practice.

2.03 OTHER MATERIALS:

A. Waterstops

Waterstops shall be equal to those manufactured by Vinylex Corporation, Knoxville, Tennessee; Vulcan Metal Products, Inc., Birmingham, Alabama; or Grace Construction Products, Cambridge, Massachusetts; or Sika Greenstreak, Saint Louis, Missouri. They shall be manufactured from virgin polyvinyl chloride plastic compound. The properties of the compound shall conform to U.S. Army Corps of Engineers Specifications CRD C-572. The type and size shall be as noted on the plans.

B. Expansion Joint Materials

Building interior expansion joint material shall be an isometric polymer, closed cell material. It shall be ultra-violet resistant with 99% recovery. Material shall meet requirements of ASTM D-1752, Sections 4.1 and 4.3. Exterior expansion joint material shall be asphalt impregnated fiberboard unless noted otherwise.

C. Other Materials

All other materials, not specifically described but required for proper completion of concrete work, shall be in conformance with the applicable standard(s) referenced in 1.03, and shall be as selected by the Contractor subject to approval of the Engineer.

2.04 CONCRETE MATERIALS:

A. The use of any admixture shall be subject to review and approval of the Engineer. The use of all admixtures shall be in accordance with ACI 212.2R and these specifications.

B. Regular Portland Cement

Regular Portland Cement shall conform to all the requirements for ASTM C-150 for Type I or Type II.

C. Air-Entraining Portland Cement

Air-entraining Portland Cement shall conform to all the requirements of ASTM C-150 for Type II.

D. Air-Entraining Admixtures

Air-entraining admixtures shall conform to the requirements of ASTM C-260.

E. Fly Ash and Pozzolanic Materials

Fly ash and Pozzolanic materials, when approved for use, shall conform to the requirements of ASTM C-618.

F. Chemical Admixtures

Chemical admixtures, when approved for use, shall conform to the requirements for ASTM C-494.

G. Concrete Aggregate

Concrete aggregate shall conform to ASTM C-33.

H. Water

Mixing water for concrete shall be fresh, clean, and potable. Non-potable water may be used only if it produces mortar cubes having 7 and 28 day strengths equal to the strength of similar specimens made with distilled water, when tested in accordance with ASTM C-109.

2.05 SAMPLING AND TESTING OF CONCRETE MATERIALS:

A. All tests which are necessary to determine the compliance of the concrete materials with these specifications will be performed by an approved testing laboratory with the cost of testing to be borne by the Contractor.

B. Cement

Cement may be accepted on the basis of mill tests and the manufacturer's certification of compliance with the specifications. Certificates of compliance shall be furnished the Engineer by the Contractor, for each lot of cement furnished prior to use of cement in the work.

C. Fine and Coarse Aggregate

At least two weeks in advance of the beginning of concrete work, the Contractor shall submit to the Engineer certified laboratory reports of the aggregates to establish compliance with these specifications and ASTM C-33. The sampling and testing shall conform to those listed in ASTM C-33.

D. Additional tests of aggregate gradation shall be made periodically as required by the Engineer's representative.

2.06 CONCRETE MIX DESIGN:

A. General

1. The proportion of ingredients shall be selected to produce the proper placability, durability, strength, and other required properties. Concrete for use in water containing structures must also be of high density resulting in a watertight structure.

2. The proportion of ingredients shall be such as to produce a mixture which will work readily into the corners and angles of the forms and around reinforcement by the methods of placing and consolidation employed on the work, but without permitting the materials to segregate or excessive free water to collect on the surface.

B. Concrete Strength

All concrete for sanitary structures, buildings, sidewalks, and curb and gutter shall have a 28 day compressive strength of 4,000 psi, unless shown otherwise on the Plans. Thrust blocks, manhole bases, and related utility concrete shall have a 28 day compressive strength of 3,000 psi.

C. Proportioning

Proportioning of ingredients shall conform to ACI 301 and 211, subject to the following:

- a. Maximum water-cement ratio to be 0.45, unless noted otherwise in the General Structural Notes.
- b. Minimum cement content shall be 564 lb. per C.Y.
- c. Coarse Aggregate shall be No. 67 (¾-inch maximum)

D. Air Content

Air content (as determined in accordance with ASTM C-231 or C-173) shall be 6% ± 1%.

E. Slump

Slump (as determined in accordance with ASTM C-143) shall be:

- a. 1-inch minimum
- b. 3-inch maximum for footings, caissons, substructure walls
- c. 4-inch maximum for slabs, beams, reinforced walls, columns

- F. These slump numbers do not apply when an approved water reducing agent is used. Slump shall be measured prior to the addition of admixtures.

2.07 APPROVAL AND TESTING OF CONCRETE MIX DESIGN:

A. General

At least three weeks in advance of the beginning of concrete work, the Contractor shall submit details of each proposed concrete mix design, including air content, slump, maximum size of coarse aggregate, admixtures, weight of fine aggregate per cubic yard, weight of coarse aggregate per cubic yard, water cement ratio, cement content per cubic yard, and water content per cubic yard.

B. New Mix Design

1. For any mix design not previously used, the Contractor shall submit the details of the mix design and at his own expense certifications by an independent laboratory to the following:
2. That at least one test batch using the mix design has been tested for slump in accordance with ASTM C-143 and air content in accordance with ASTM C-231 and that the test results are within the specified limits.
3. That at least three test cylinders have been made from the test batch using the mix design and these cylinders have been made and cured in accordance with ASTM C-39.
4. That the average strength of cylinders tested was a minimum of 15% greater than the strength specified and none was less than the strength specified.

C. Previously Used Mix Design

Where the Contractor has previously used a proposed mix design with materials from the same sources and under similar conditions as anticipated, he shall submit with the mix design details the reports for at least nine (9) cylinder tests for 28 day concrete compressive strength made during the last six months. The average strength must exceed the specified strength by at least 10% and none of the tests shall fall below the specified strength. Test requirements shall be identical to Paragraph 2.07 B. herein.

2.08 CONCRETE PLANT REQUIREMENTS:

A. Storage of Materials

1. Cement shall be stored in weather-tight buildings, bins, or silos which will provide protection from dampness and contamination and will minimize warehouse set.
2. Aggregate stockpiles shall be arranged and used in a manner to avoid segregation or contamination with other materials or with other sizes of like aggregates. To ensure that this condition is met, any test for determining conformance to requirements for cleanness and grading shall be performed on samples secured from the aggregates at the point of batching. Stockpiles shall be built in successive horizontal layers not exceeding three feet in thickness, with each layer being completed before the next is started. Frozen or partially frozen aggregates shall not be used. Sand shall be allowed to drain until it has reached uniform moisture content before it is used.
3. Admixtures shall be stored in such a manner as to avoid contamination, evaporation, or damage. For those used in the form of suspensions or non-stable solution, suitable agitating equipment shall be provided to assure uniform distribution of the ingredients. Liquid admixtures shall be protected from freezing and other temperature changes which would adversely affect their characteristics.

B. Admixtures

1. If approved by the Engineer, admixtures shall be used provided the Contractor submits certified test results showing no detrimental effects on the concrete. Such admixtures,

including air-entraining admixtures, pozzolanic materials, and proprietary chemical admixtures, shall be used in strict accordance with the recommendations of the manufacturer. Proposals for use of admixtures shall be submitted to the Engineer at least 3 weeks in advance of the date of proposed use.

2. If approved by the Engineer, an accelerator may be used in the proportions recommended by the manufacturer when the air temperature is less than 40°F. Calcium chloride shall not be used.
3. If approved by the Engineer, a water-reducing agent may be used in the proportions recommended by the manufacturer when the temperature of the concrete as placed exceeds 65°F.

C. Mixing of Concrete

Ready-mixed concrete shall be measured and transported in accordance with ASTM C-94. Batch mixing at the site shall not be allowed without written permission from the Engineer. Batch mixing, if permitted shall conform to ACI 304. Hand mixing shall not be permitted.

D. Weather Conditions

1. Cold Weather

- a. To maintain the temperature of the concrete above the minimum placing temperature required by these specifications, the as-mixed temperature shall not be less than 55° F. when the mean temperature falls below 40° F.
- b. If the water or aggregate has been heated, the water shall be combined with the aggregate in the mixer before cement is added. Cement shall not be added to mixtures of water and aggregate when the temperature of the mixture is greater than 100° F.

2. Hot Weather

The ingredients shall be cooled before mixing if necessary to maintain the temperature of the concrete below the maximum placing temperature required by 3.05 of this Section.

E. Testing

Concrete delivered to the project will be tested as required in 3.00 EXECUTION of this Section.

3.00 EXECUTION

3.01 GENERAL:

All work under this Section shall be constructed in the locations, and to the lines, grades, details and dimensions shown on the Contract Drawings. All complete cast-in-place concrete structures shall meet the tolerances specified in ACI 301.

3.02 FORMWORK:

A. General

The design, construction, erection, use and removal of all formwork shall be the responsibility of the Contractor. All such materials and work shall be in accordance with the recommendations, guidelines, and requirements of ACI 347 and SP-4.

B. Form Design

1. Formwork should be designed so that all components and members of the structure will be cast to the correct dimensions, shape, alignment, elevation, and position. Formwork should also be designed to be erected, supported, braced, and maintained so that it will safely support all vertical and lateral loads that might be applied until such loads can be supported by the concrete structure.
2. Formwork and falsework vertical and lateral loads should also include live loads, wind loads, and construction loads together with appropriate safety factors and load multipliers as recommended by ACI 347.
3. All formwork should be mortar tight. Tie systems should provide for positive pressure at all joints to preclude grout leakage.

C. Form Ties

1. Form tie assemblies for sanitary structures should permit tightening of the forms and be of such type as to leave no metal or other material within 1-1/2" of the surface. The assembly should provide cone-shaped depressions at the surface at least 1" in diameter and 1-1/2" deep to allow filling and patching. Ties should be tight fitting, or tie holes in forms should be sealed to prevent leakage where ties penetrate the form.
2. When a portion of single rod ties are to remain in a liquid-retaining structure, the portion that is to remain should be provided with a tightly fitted water-stop washer at mid-point. Multi-rods do not require washers. Through ties that are to be entirely removed from the structure should be tapered over the portion which passes through the concrete.

D. Form Coating or Release Agents

Form surfaces which will be in contact with concrete should be coated with an effective bond-breaking form coating prior to placing steel, in accordance with ACI 347 (See 2.01 D of this section).

E. Inspection Before Concreting

Prior to placing concrete, forms shall be inspected for cleanliness, accuracy of alignment, and reinforcing steel clearances. Inspection ports shall be provided to facilitate cleaning and inspection of the interior of the formed elements immediately before concrete is placed.

F. Removal of Forms

1. Removal of forms shall be in accordance with ACI 347.
2. In hot, dry weather conditions, wood forms remaining in place do not provide adequate curing but should be removed or loosened so that the concrete surfaces can be kept moist or coated with a curing membrane. In cold weather, removal of formwork should be deferred or formwork should be replaced with insulation blankets to avoid thermal shock and consequent crazing of the concrete surface.
3. Removal of the forms does not relieve the Contractor of his responsibility to provide the required curing of the concrete or protecting the exposed work.
4. Any damage to concrete after removal of the forms due to insufficient curing, weather, or the Contractor's operations shall be repaired or reconstructed to the Engineer's satisfaction.
5. Reshoring, if permitted, shall be in accordance with ACI 347.

3.03 REINFORCEMENT:

A. Fabrication and Placement

Fabrication and placement of reinforcing steel shall be according to the Plans, CRSI Manual of Standard Practice, and Shop Drawings. Tolerances shall be as specified in ACI 3.01. Bars may be moved as necessary to avoid interference with other reinforcing steel, conduits, or embedded items. If bars are moved more than one bar diameter or enough to exceed the above tolerances, the resulting arrangement of bars shall be subject to approval. All cutting and bending of reinforcing shall be done in a suitably equipped shop. No cutting or bending shall be permitted at the job site.

B. Splices

Welded splices of reinforcing will not be permitted. Bars in lap splices shall be lapped at least 30 bar diameters, or in accordance with the referenced CRSI manual.

3.04 JOINTS AND EMBEDDED ITEMS:

A. Construction Joints

1. Joints not shown on the plans shall not be made without the approval of the Engineer.
2. All reinforcing steel and welded wire fabric shall be continued across joints. Keys shall be provided.
3. The surface of the concrete at all joints shall be thoroughly cleaned by water jetting and all laitance and other contaminants removed. Surface shall be dampened prior to placing fresh concrete.

B. Expansion Joints

Reinforcement or other embedded metal items bonded to the concrete (except dowels in floors bonded on only one side of joint) shall not be permitted to extend continuously through any expansion joint.

C. Waterstops

1. Each piece of pre-molded waterstop shall be of maximum practical length in order that the number of end joints will be held to a minimum.
2. Joints at intersections and at ends of pieces shall be made in the manner most appropriate to the material being used. Joints shall develop effective water tightness fully equal to that of the continuous waterstop material and shall permanently develop not less than 50 percent of the mechanical strength of the parent section and shall permanently retain its flexibility. Tie each edge of waterstop to reinforcing with wire ties spaced at a maximum of 16 inches on center to positively prevent movement during concreting.

D. Other Embedded Items

1. All sleeves, inserts, anchors, and embedded items required for adjoining work or for its support shall be placed prior to concreting.
2. All contractors shall be given ample notice and opportunity to introduce and/or furnish embedded items before the concrete is placed.

E. Placing Embedded Items

Expansion joint material, waterstops and embedded items shall be positioned accurately and supported against displacement. Voids in sleeves, inserts, and anchor slots shall be filled temporarily with readily removable material to prevent the entry of concrete into the voids. Particular care shall be taken to fully embed waterstop material without entrapping air adjacent to the stop. Positioning of waterstop and concrete vibration shall be such as to ensure dense concrete around and in contact with the waterstop.

3.05 PLACING CONCRETE:

A. Preparation Before Placing

1. The Contractor shall give notice to the Engineer at least two days before placing concrete. Unless adequate protection is provided and approval is obtained, concrete shall not be placed during rain, sleet or snow.
2. Hardened concrete and foreign materials shall be removed from the inner surfaces of the conveying equipment.
3. Formwork shall have been completed; ice and excess water shall have been removed; reinforcement shall have been secured in place; water stops, expansion joint material, anchors, and other embedded items shall have been positioned; and the entire preparation shall have been approved.

4. Semi-porous subgrades shall be sprinkled sufficiently to eliminate suction and extremely porous subgrades shall be sealed in an approved manner.

B. Tempering and Control of Mixing Water

1. Concrete temperatures shall remain between 55°F and 90°F while it is being placed. Precast concrete that is heat cured per WSDOT Section 6-02.3(25)D shall remain between 50°F and 90°F while being placed. The batch of concrete shall be discharged at the project site no more than 1½ hours after the cement is added to the concrete mixture. The time to discharge may be extended to 1¾ hours if the temperature of the concrete being placed is less than 75°F. With the approval of the Engineer and as long as the temperature of the concrete being placed is below 75°F, the maximum time to discharge may be extended to 2 hours. When conditions are such that the concrete may experience an accelerated initial set, the Engineer may require a shorter time to discharge. The time to discharge may be extended upon written request from the Contractor. This time extension will be considered on a case by case basis and requires the use of specific retardation admixtures and the approval of the Engineer. (WSDOT 6-02.3(4)D)
2. When concrete arrives at the project with slump below that suitable for placing, water may be added only if neither the maximum permissible water-cement ratio nor the maximum slump is exceeded. The water shall be incorporated by additional mixing equal to at least half of the total mixing required.

C. Conveying

1. Concrete shall be handled from the mixer to the place of final deposition by methods which will prevent separation or loss of ingredients and in a manner which will assure that the required quality of the concrete is obtained. Conveying equipment shall be of size and design to ensure a continuous flow of concrete at the delivery end. Concrete shall be deposited, as nearly as practical, in its final position horizontally.
2. Concrete conveying equipment shall be designed specifically to place concrete. Conveyor systems shall not impair the strength, slump, or air content of the concrete placed. The placement system must be capable of delivering concrete continuously over the entire placement area without delays for equipment relocation.

a. Buckets

Bottom-dump buckets may be used for transporting mixed concrete to the desired location. Particular care should be taken to avoid jarring or bumping which may cause segregation.

b. Chutes

Chutes used to transport concrete shall be of metal or wood with metal lining and shall have a slope not exceeding one vertical to two horizontal and not less than one vertical to three horizontal so that the concrete will travel fast enough to keep the chute clean but slow enough to avoid segregation of materials. The end of each chute should be provided

with a baffle to help prevent segregation, or the concrete should be discharged through a tremie or elephant trunk directly into the form.

c. Elephant Trunks and Tremies

Elephant trunks and/or tremies shall be used in walls and columns to prevent free-fall of the concrete and allow the concrete to be placed through the case of reinforcing steel. They shall be moved at short intervals to prevent stacking of concrete and needing vibrators to move the mass.

d. Pumping

Pumping equipment shall be a suitable type with adequate pumping capacity. Loss of slump in pumping should not exceed 1-½ inches.

D. Placement

1. To prevent segregation, the concrete shall be deposited in approximately horizontal layers of 18 to 24 inch as near as possible to its final position. It should not be allowed to drop freely more than 4 ft. (except start of wall pours shall drop less than 2 ft.) or through a cage of reinforcing steel (see C.3. above).
2. Sections of walls between joints should be placed continuously to produce a monolithic unit. At least 48 hours should elapse between casting of adjoining units.
3. Placing of concrete in beams or slabs should not begin until the concrete previously placed in wall or columns has attained initial set. As soon as possible after concrete has been deposited, it should be consolidated in an approved manner to work the concrete around reinforcement and inserts and to prevent formation of voids. Each horizontal layer should be consolidated by the use of approved mechanical vibratory equipment. The vibrator should extend into the underlying layer to bond the two layers together. To avoid excessive pressure on the forms, the vibrator should penetrate no more than 2 ft. into the underlying layer. The use of vibrators to move concrete horizontally within the forms is not allowed. Mechanical high frequency vibrators with a minimum frequency of 7,000 revolutions per minute are preferred for consolidation of the concrete within the forms. The concrete should not be vibrated long enough to cause segregation of the aggregate. For details refer to ACI 309.

E. Back-up Placement Systems

Alternate placing equipment should be immediately available for use in the event that the primary placing equipment or system breaks down during a placement. Such equipment should be able to commence placing operations with thirty minutes notice to avoid cold joints in the structural element being placed.

F. Portholes in Wall and Column Forms

Temporary openings or portholes in wall or column forms may be used to limit the free-fall of the concrete to less than 4 ft. and should be so located to facilitate the placing and consolidation of the concrete. The ports should be spaced no more than 6 to 8 ft. apart to limit the horizontal flow of concrete and to prevent segregation.

G. Cold Weather

Unless the temperature is at least 40° F and rising, water and/or aggregates should be heated so that the temperature of the concrete, when placed, is not less than 55°F. Provisions should be made for maintaining the concrete at a minimum temperature of not less than 50° F for a period of at least 7 days. Detailed recommendations are given in ACI 306R. Because of potential dangers, form removal should be governed by attainment of adequate strength in the field-placed concrete.

H. Hot Weather

1. When the ambient temperature is 90° F or above, special precautions should be taken during mixing, placing, and curing. Aggregate and cement should be kept cool. The use of a set-retarding admixture may be beneficial, particularly with shrinkage-compensating concrete.
2. Sometimes it is desirable to cool the mixing water by the use of nitrogen, by refrigeration, or by replacing part of the water with shaved or crushed ice.
3. Curing of the concrete should be started as soon as finishing has been completed and/or the water sheen has disappeared. If liquid membrane curing is used (see Section 3.07), the compound should be white pigmented.
4. Detailed recommendations for hot weather concreting are given in ACI 305R.

3.06 SURFACE FINISH:

A. Surface Defects, Tie Holes

Repair of surface defects should be in accordance with Chapter 9 of ACI 301.

1. Tie Holes

After being thoroughly cleaned and dampened, the tie holes shall be grouted solid with a nonmetallic non-shrinking grout. The tie hole should be packed solid by rodding. The grout material and the entire tie hole filling process shall be approved by the Engineer prior to the start of work.

2. Patching Minor Defects

- a. Surfaces to be patched or repaired after removal of forms should be corrected by approved methods and not merely by plastering over them. Patching of defective areas shall be done as soon as the forms can be removed and before curing compound is applied.
- b. A good patch well-bonded to adjacent concrete is essential. Non-shrink, non-staining grout shall be used. Curing requirements for patches should be the same as for the mass of the concrete.

3. Honeycombed Areas

Honeycombed sections may result from improper placement and inadequate vibration. Whether patching of honeycombed areas is permissible depends on the extent and depth of the defective concrete and its location. If patching is allowed, all unsound material must be chipped out back to sound, solid concrete and inspected prior to the start of filling and patching operations.

B. Formed Surfaces (Chapter 10, ACI 301)

1. Exterior below grade surfaces – formed surfaces shall have a “smooth form finish”, per paragraph 10.2.2, ACI 301.
2. Exterior above grade and interior surfaces – formed surfaces shall have a “grout cleaned finish”, per paragraph 10.3.2, ACI 301.
3. Fluid containing structures and channels, water-side below water and above water – formed surfaces: hardened concrete shall be blasted with high-pressure (3000 psi or greater) water stream to remove any loose concrete. Surface imperfections greater than ¼ dimension including all form ties holes shall be pointed up with cement type grout, flush with the concrete surface.

C. Slabs (Chapter 11, ACI 301)

Detailed recommendations are given in Section 6.4.4 and Chapter 7 of ACI 302.1R. Concrete should be spread evenly ahead of the strike off and worked as little as possible during early finishing operations. Any water brought to the surface by the strike off or rough floating should be allowed to evaporate. If the amount of water or laitance is excessive, it should be removed before the surface is again floated or troweled. Final troweling should be delayed as long as possible. Generally, the proper time for final troweling is after the surface water has disappeared and when the troweling should only be as required to produce the specified finish and close any surface cracks that may have developed.

1. Interior floor slabs and water containing structure slabs shall have a floated and troweled finish, paragraph 11.7.3.
2. Sidewalks shall have a light broomed finish, paragraph 11.7.4.
3. Base slabs in wet wells shall have a scratched finish, paragraph 11.7.1., to receive grout fill.

D. Curbs

The face form of curbs shall be stripped at such time in the early curing as will enable inspection and correction of all irregularities. Forms shall not be removed until the concrete has set sufficiently to retain its true shape. The face of the curbs shall be troweled and the exposed surface of the curbs shall be brushed with a fiber hair brush.

3.07 CURING:

A. General

1. Proper curing of fresh concrete requires that moisture be retained to promote additional hydration of cement during the curing period and to prevent formation of surface cracks due to rapid loss of water while the concrete is plastic. Detailed requirements are given in ACI 308.
2. When surfaces are cured with membrane curing compound, all finishing operations, except grinding, chipping, bush hammering, and sandblasting, should be completed prior to application of the membrane.
3. Curing should commence immediately following initial set or completion of surface finishing. Various methods commonly used include leaving forms in place, sprinkling, ponding, using moisture-retaining covers, or applying a liquid seal coat to form a thin water-impervious membrane.
4. The membrane curing compound should cover the entire surface to be cured with a uniform film that will remain in place without gaps or omissions for the full duration of the curing period. Exposed steel, keyways, or concrete to be surfaced should be protected from the curing compound.

B. Duration of Curing

1. Curing shall continue until the cumulative number of days or fractions thereof, during which temperature of the air in contact with the concrete is above 50° F has totaled seven days. If high-early strength concrete has been used, curing shall continue for a total of three days. Rapid drying at the end of the curing period shall be prevented.
2. Steel forms heated by the sun and all wood forms in contact with the concrete during the curing period shall be kept wet. If forms are to be removed during the curing period, curing per above shall be done immediately. Such curing shall be continued for the remainder of the curing period.

3.08 CONCRETE TESTING:

A. Concrete shall be sampled and tested by a certified testing agency at the Contractor's expense in accordance with ACI 301 and supplements during the progress of concrete work. Slump and air content tests shall accompany all test cylinders for strength. Engineer shall be notified 48 hours ahead of all scheduled pours. Contractor shall notify Engineer 24 hours in advance of any cancellation of pours.

1. When there is a question as to quality of the structure because of cylinder strength test failures, strength tests made on specimens secured from the structure and testing in accordance with ASTM C-42 will be required.
2. Samples of concrete will be obtained in accordance with ASTM C-172 and will be transported to a place on the site where air and slump tests can be made and cylinders stored

without being disturbed for the first 24 hours. Cylinders for strength tests will be made in accordance with ASTM C-31 and ASTM C-94.

3. Concrete failing to meet the requirements of these specifications shall be deemed unacceptable and shall be removed from the structure if so required by the Engineer.
- B. Cylinders shall be made as required by ACI 301, and supplements for strength tests following applicable ASTM standards. Cylinders shall be cured in the laboratory. If a specimen shows evidence of improper sampling, molding or testing, it will be discarded.
 - C. Slump and air tests shall be made following the procedure in ASTM C-143. Slump tests shall be made for concrete from any batch from which strength tests are made. If the measured slump falls outside limits specified, a check test will be made immediately on another portion of the same sample. In the event of a second failure, concrete will be considered to have failed to meet requirements of the specifications and shall be unacceptable.
 - D. Air content tests shall be made in accordance with either ASTM C-138 or ASTM C-231. If the measured air content falls outside limits specified, a check test will be made immediately on another portion of the same batch. In the event of a second failure, concrete will be considered to have failed to meet requirements of the specifications and shall be unacceptable.
 - E. Water tightness, testing and repair: All concrete tanks and channels which will be subjected to hydrostatic pressure and have walls and slabs which are common with areas to be occupied by equipment or personnel, or are exposed outdoors, shall be tested for water tightness. Tests shall be made prior to application of waterproofing or protective coatings. Testing shall consist of filling the tank with water to the maximum operating water surface. All leaks revealed by the test shall be repaired by injection grouting or other means as specified herein. The Engineer may direct Contractor to retest any tanks or channels which have been repaired to check the suitability of repairs. Water required for testing shall be provided by Contractor and disposed of so as not to create a nuisance.

3.09 ACCEPTANCE OF STRUCTURE:

A. General

1. Completed concrete work which meets all applicable requirements will be accepted without qualification.
2. Completed concrete work which fails to meet one or more requirements but which has been repaired to bring it into compliance, will be accepted without qualification.
3. Completed concrete work which fails to meet one or more requirements and which cannot be brought into compliance may be accepted or rejected as provided in these specifications.

B. Concrete Compressive Strength

If a concrete strength test is not satisfactory, that portion of the structure represented shall be considered deficient in strength and subject to the provisions of Paragraph C. below, "Acceptance of Strength".

C. Acceptance of Strength

1. Strength of Structure

The strength of a concrete element in place will be considered deficient if it fails to comply with any requirements which control the strength of the structure, including, but not necessarily limited to the following conditions:

- a. Low concrete strength as evaluated by concrete strength tests already made;
- b. Reinforcing steel size, quantify, strength, position, or arrangement at variance with the requirements of these specifications or the project plans;
- c. Concrete which differs from the required dimensions or locations in such a manner as to reduce the strength;
- d. Curing less than that specified;
- e. Inadequate protection of concrete from extremes of temperature during early states of hardening and strength development;
- f. Mechanical injury, construction fires, accidents, or premature removal of formwork likely to result in deficient strength;
- g. Poor workmanship likely to result in deficient strength; and
- h. Leakage from fluid containing structures.

2. Structural Analysis

Where the strength is considered deficient, but the Engineer's analysis indicates the completed structure is suitable for its intended use, the structure may be accepted.

3. Additional Testing

Where the strength is considered deficient due to low concrete strength tests, the Contractor may, at his own expense, provide core testing. Results of such tests will be taken as governing over molded specimen tests. Such sampling and testing shall be as approved by the Engineer, and in conformance with ATM C-42.

4. Rejected Concrete

A concrete element considered as deficient in strength shall be rejected. Rejected concrete shall be removed and replaced. Limits of removal shall be as directed by the Engineer to accomplish a structure equal in strength, serviceability, and appearance, to that which would have been achieved by acceptable concrete.

5. Expense of Repairs

The cost of all additional engineering, analysis, repairs, removal, replacement, etc., required by the provisions of this Section shall be borne by the Contractor.

D. Dimensional Tolerances

1. Formed surfaces resulting in concrete outlines smaller than required, by an amount exceeding the requirements of ACI-347, shall be considered deficient in strength and subject to the provisions of paragraph C, Acceptance of Strength.

2. Formed surfaces resulting in concrete outlines larger than required, by an amount exceeding the requirements of ACI-347, may be rejected and the excess material shall be subject to removal. If removal of the excess material is permitted, it shall be accomplished in such a manner as to maintain the strength of the section and to meet all other applicable requirements of function and appearance.
3. Concrete members cast in the wrong location may be rejected if the strength, appearance, or function of the structure is adversely affected or misplaced items interfere with other construction.
4. Inaccurately formed concrete surfaces exceeding the requirements ACI-347, may be rejected and shall be repaired or removed and replaced as required by the Engineer. Finished flatwork exceeding the tolerances of ACI-301 shall be repaired or replaced so that water tightness (if applicable), strength and appearance are not adversely affected. High spots may be removed with a terrazzo grinder, low spots filled in with a patching compound, or other remedial measures performed as permitted by the Engineer.

E. Appearance

Concrete exposed to view with defects which adversely affect the appearance of the specified finish shall be repaired. If, in the opinion of the Engineer, the defects cannot be repaired, the concrete shall be rejected.

3.10 DISINFECTION AND TESTING OF FLUID CONTAINING STRUCTURES:

A. Disinfection of Structures Containing Potable Water

Disinfection of the completed structure shall comply with the provisions of AWWA C652 and C653. The Owner will take the bacteriological sample(s) required and provide laboratory analysis of same. The Contractor shall notify the Owner when such samples may properly be taken. Scheduling and the time required to take samples and obtain results will be determined by laboratory availability and scheduling. Flushing of the structure and disposal of the water, if required, shall be in accordance with local, state and federal regulations regarding such water.

B. Leakage Testing

1. General

All concrete basins shall be hydrostatically tested for leaks. All testing shall be done in the presence of the Engineer. Water for testing will be provided by the Owner. The Contractor shall be responsible for transporting the water as specified in Section 01020.

2. Testing

- a. Structures which are to contain fluid shall be filled by the Contractor to maximum design depth before any finish is applied. Testing shall not occur prior to all portions of the structure achieving the specified strength, as indicated by the strength tests. Additional cylinders and strength tests may be made for the purpose of establishing the cure time required to produce the design strength. Testing may be done before or after backfill of

the structure, at the Contractor's sole option. The filled tank shall set for at least 24 hours before starting liquid level measurements to check leakage. Evaporative losses shall be measured and deducted from the measured liquid level drop to determine leakage amount.

- b. Water loss greater than 0.05 of 1% of the structure capacity in 72 hours shall be considered unacceptable. No visible leaks shall be allowed. If the leakage exceeds the maximum allowable, the leakage test may be extended to a total of five days. If at the end of five days average daily leakage does not exceed the maximum allowable average daily leakage, this test shall be considered satisfactory.
- c. Damp spots on exterior wall surfaces shall not be permitted. Damp spots are defined as spots where moisture can be picked up on a dry hand. The source of water movement through the wall shall be located and permanently sealed on the structure interior in a manner approved by the Engineer. Leakage through the wall-base joint or footing shall likewise be corrected.
- d. If leakage exceeds that specified, the structure will not be accepted until all leaks are sealed on the structure interior in a manner approved by the Engineer as equal to watertight concrete in durability, strength and protection of reinforcing steel. Proof of leak stoppage shall be accomplished by the Contractor by again filling the structure and repeating the test.

4.00 MEASUREMENT AND PAYMENT

4.01 GENERAL:

- A. See Section 01 22 00 – Measurement and Payment for General Requirements. See Section 01 01 00 – Special Requirements/Bid Items for possible modifications to Standard Bid Items.
- B. If no specific bid item is provided, measurement and payment shall be considered incidental and shall be included in the bid price for other items of work for the project.

4.02 BID ITEMS:

- A. Special provisions, requirements, revisions to these Bid Items, and/or additional Bid Items, may be included in Section 01 01 00 (green pages) or on the Drawings or Details.
- B. Cast-in-Place Concrete
 - 1. Includes forming, furnishing and placing all cast-in-place concrete as shown on the Drawings. Also included are all reinforcing and appurtenances, as well as testing and disinfection as applicable.
 - 2. Payment shall be made on a unit price Cubic Yard (C.Y.) or Lump Sum (L.S.) or per structure basis.

****END OF SECTION****

1.00 GENERAL

1.01 DESCRIPTION:

- A. The work included in this Section consists of furnishing and installing pre-cast concrete manholes, wet wells and dry wells, including steps, pipe connections, drop connections, channels, special drain rock backfill, grouting, top slabs, adjustment rings, frames and covers.
- B. Special provisions, requirements and/or revisions to this Specification and/or Bid Items(s) may be included in Section 01 01 00 (green pages) and/or on the Drawings or Details.

1.02 QUALITY ASSURANCE:

Precast concrete manholes, wet wells and dry wells shall conform to the requirements of ASTM C-478, except as specifically modified herein.

1.03 SUBMITTALS:

Submittals shall conform to Section 01 33 00 of these Specifications and shall include complete manufacturer's literature, shop drawings and details of manholes, wet wells, and dry wells.

1.04 JOB CONDITIONS:

The Contractor shall make all arrangements for sufficient product storage area prior to delivery. All work shall be confined within easements and rights-of-way, unless other arrangements are made with adjacent property owners.

2.00 PRODUCTS

2.01 GENERAL:

All manholes, wet wells, and dry wells shall be constructed of pre-cast reinforced concrete with pre-cast bases.

2.02 CONCRETE:

Cement shall be Type II per ASTM C150. Minimum portland cement content shall be 564 pounds per cubic yard. Water/cement ratio shall not exceed 0.49. Minimum 28-day compressive strength shall be 3,000 psi.

2.03 PRECAST MANHOLE AND DRY WELL SECTIONS:

A. General

- 1. Except as shown otherwise on the Drawings, pre-cast manholes and dry wells shall be minimum 48-inch diameter, conforming to ASTM C478, except the wall thickness shall be 4-inch minimum.

2. Provide eccentric cones for manholes and dry wells or as shown on Drawings. Cones shall have same wall thickness and reinforcement as manhole sections. Top and bottom of cone shall be parallel. Manhole steps shall be cast in the sections by the manufacturer. Manhole joints shall be confined rubber gaskets conforming to ASTM C443. Provide preformed knockouts or cutout holes for pipe, or core drill in field.

B. Testing:

If requested by the Engineer, and prior to delivery of any pre-cast section, tests shall be conducted at the manufacturer's plant at no additional cost to the Owner. The pre-cast sections to be tested will be selected at random from the stockpiled material which is to be supplied for the job. All test specimens will be mat tested and shall meet the permeability test requirements of ASTM C14. The manufacturer shall furnish a written certification of test results to the Engineer if required.

C. Manhole Extensions:

Concrete grade rings for extensions shall be a maximum of 6 inches high, and constructed to the same standards as pre-cast manhole sections. Minimum reinforcement shall be one No. 4 bar.

2.04 MANHOLE STEPS:

Manhole steps shall be Grade 60 No. 4 bar reinforced copolymer polypropylene plastic, or substitute acceptable to Engineer. Manhole steps shall have integral restrains to prevent side slippage of feet.

2.05 PIPE ADAPTERS:

Manhole pipe adapters for entry coupling of pipe shall be Kor-N-Seal or a PVC manhole adapter as manufactured by GPK Products, Inc., or a Dura-Seal III gasket as manufactured by Dura-Tech, Inc., or approved equal. Gasket material shall comply with the provision of ASTM D2000 3 BA715.

2.06 FRAMES AND COVERS:

Frames shall be cast iron conforming to the provisions of ASTM A48, Class 30 or better, or ductile iron conforming to the provisions of ASTM A536, Grade 80-50-06, minimum weight 158 pounds. Non-skid manhole covers shall be ductile iron conforming to the provisions of ASTM A536, Grade 80-55-06, minimum weight 118 pounds, with word "sewer" embossed. Provide 1" diameter pick hole in cover. If required in Section 01 01 00, bolt down tamperproof frames and covers shall be provided. Grates for dry wells shall be ductile iron conforming to the provisions of ASTM A536, Grade 80-55-06 unless otherwise specified on the plans. Frames and covers shall provide a minimum 24-inch diameter opening. Strength requirements shall be per Fed. Spec. RR-F-621D. Castings shall be free of porosity, shrink cavities, cold shots or cracks, and all surface defects which impair serviceability. Frames and covers shall be machine ground on seating surfaces so as to insure non-rocking fit in any position and interchangeability.

2.07 WATERTIGHT FRAME AND COVER:

Watertight frames and covers shall comply with all requirements of this section and shall provide the following:

3/8" x 1/4" machined groove in frame, 3/8" square neoprene gasket set in groove, three locations drilled and tapped for 5/8" stainless steel Allenhead bolts, solid cover with integral lifting pocket.

2.08 NON-SHRINK GROUT:

Grout for sealing lifting holes, joints and pipe connections shall be non-metallic non-shrink grout, and shall be Five-Star Grout as manufactured by U.S. Grout Corporation, or approved equal.

2.09 BEDDING:

Bedding material for under manhole and wet well bases shall be pipe bedding material as specified in Section 31 23 00.

2.10 SPECIAL BACKFILL FOR DRY WELLS:

Unless other or additional requirements are required by the Drawings, special backfill material for dry well installation or restoration shall be washed natural gravel with a maximum size of 3" and a minimum size of 1-1/2".

2.11 OTHER MATERIALS:

All other materials not specifically described in this Section but required for a complete operating installation, shall be new, first quality of their respective kinds as selected by the Contractor subject to approval of the Engineer.

3.00 EXECUTION

3.01 EXCAVATION, BACKFILL AND COMPACTION:

A. General

All excavation, bedding, backfilling and compaction for manholes, wet wells and dry wells shall conform to Section 31 23 00, unless required otherwise herein or on the Drawings.

B. Bedding

Pre-cast manhole and wet well base sections shall be placed on a well-graded granular bedding course 6" in thickness and extending either to the limits of the excavation or to a minimum of 12" outside the outside limits of the base section. In the latter case, the balance of the excavated area shall be filled with select material well tamped to the level of the top of the bedding to positively prevent any lateral movement of the bedding when the weight of the concrete structure is placed upon it. The bedding course shall be firmly tamped and made smooth and level to assure uniform contact and support of the pre-cast elements.

3.02 INSTALLATION:

A. Pre-cast Sections

1. Sections shall be carefully checked upon delivery to the site and again after installation. Any damaged sections that cannot be satisfactorily repaired to the satisfaction of the Engineer shall be removed and replaced at no additional cost to the Owner.
2. Manhole and wet well base sections shall be carefully placed on the prepared bedding so as to be fully and uniformly supported in true alignment, and making sure that all entering pipes can be inserted on proper grade. Pre-cast sections shall be placed and aligned to provide vertical sides and vertical alignment of the ladder rungs (where applicable). All lift holes and joints shall be thoroughly wetted and then be completely filled with non-shrink grout, smoothed and pointed both inside and out, to ensure water tightness.
3. In pre-cast manhole sections where steel loops have been provided in lieu of lift holes, the loops shall be removed flush or below the surface after the manhole has been completed. No sharp cutoff protrusions will be permitted. If concrete spalling occurs as a result of the loop removal or a recessed area exists, the area shall be restored in a workmanlike manner to a uniform smooth surface with mortar.

B. Steps

Steps shall be firmly secured to the manhole sections, shall be evenly spaced 12 inches on center and vertically aligned as shown on the Drawings, and shall project uniformly from the inside wall. Steps shall be cast in manhole sections or installed by being driven into a drilled or formed hole per manufacturer's recommendations. Chipping out or drilling an oversized hole and grouting in the steps will not be acceptable.

C. Pipe Connections

1. Each pipe connection to a manhole, wet well or dry well shall be as shown on the Drawings and as specified herein. Entry couplings shall be installed per manufacturer's recommendations. The opening shall be preformed or cored. Breaking an opening with a sledge hammer or other impact device is not acceptable.
2. The ends of all pipes shall be trimmed flush with the inside walls unless otherwise shown on Drawings. All joints and all openings cut through the walls shall be completely grouted and watertight on both inside and outside surfaces.

D. Channels

1. Channels shall be made to conform accurately to the sewer grade and shall be brought together smoothly with well-rounded junctions satisfactory to the Engineer. Channel sides shall be carried up vertically to the crown elevation of the various pipes, and the concrete shelves shall be smoothly finished and warped evenly with slopes to drain. Channel sections shall not be smaller than the connecting pipes. Channel surface shall have a smooth trowel finish. All channels with deviations not acceptable to the Engineer shall be removed and reconstructed at no additional cost to the Owner.

2. A temporary plywood cover shall be provided and installed on each manhole to protect the finished and cleaned channel. Any debris shall be removed before the cover is finally removed for installation of the permanent cast iron frame and cover. The only exception to providing this temporary cover is when a manhole frame and cover is immediately installed in place after the channel is completed.

E. Adjusting to Grade

Only pre-cast concrete adjustment rings shall be used in manhole or dry well construction. Bricks, rock fragments, or other materials are not acceptable. Preliminary manhole rim elevations are shown on the Drawings. The Contractor shall set the rim elevations to the elevation and slope of the surrounding final pavement or ground as directed by the Engineer. All adjustment rings and shims shall be mortared in place. The adjustment section shall then receive a 3/8" coating of mortar grout on the inside and outside. The frame shall also be set in mortar.

3.03 TESTING:

- A. Manholes requiring testing, and all wet wells, shall be tested by either the vacuum or the exfiltration method, as directed by the Engineer or indicated on the Plans. A minimum of 20% of the manholes shall be tested. After completion of manholes the Engineer will inform the Contractor which manholes shall be tested. Prior to testing, the manhole shall be completely constructed, and all inlet and outlet pipes shall be plugged.

1. Exfiltration Method

The Contractor shall fill the manhole with water to a depth of six feet (unless indicated otherwise on the Drawings) above the highest pipe invert with water. Four hours after the manhole has been filled, the Contractor shall refill the manhole to the original water level and commence the test. The Contractor shall keep the water surface to the 6-foot level for a 2-hour period. The leakage rate shall not exceed 0.2 gallons per hour per foot of test head above the pipe invert elevation. Manholes or wet wells which fail the test shall be repaired and retested until they pass.

2. Vacuum Method

- a. Before any testing the Contractor shall get approval from the Engineer for all equipment, gages and methods. Prior to testing, plug influent and effluent pipes.
- b. The test head shall be placed at the top of the CI frame to test the entire manhole height including grade rings.
- c. A vacuum of 10 inches of mercury shall be drawn and the vacuum pump shut off. With the valves closed, the time shall be measured for the vacuum to drop to 9 inches. The manhole shall pass if the test time is in accordance with the following table:

MANHOLES, WET WELLS AND DRY WELLS

Depth of Manhole	Minimum Time (sec.)		
	48" Dia. MH	60" Dia. MH	72" Dia. MH
4 or less	7	9	11
6	11	14	17
8	14	18	23
10	17	23	28
12	21	28	34
14	25	32	40
16	28	37	45
18	32	41	51
20	35	46	57
22	39	51	62
24	42	55	68
26	46	60	74
28	49	64	80
30	53	69	85

- B. The Contractor shall repair and retest all manholes that fail the test, at no additional cost to the Owner. The method of repair shall be acceptable to the Owner.

3.04 INSPECTION:

All manholes, wet wells, and dry wells shall be completely clean prior to request for final inspection. Cleaning shall include, but not be limited to: debris removal; removal of mortar, dirt, and asphalt from steps; and removal of asphalt from the manhole frame and cover.

4.00 MEASUREMENT AND PAYMENT

4.01 GENERAL:

- A. See Section 01 22 00 - Measurement and Payment for General Requirements. See Section 01 01 00 - Special Requirements/Bid Items for possible modifications to Standard Bid Items.
- B. If no specific bid item is provided, measurement and payment shall be considered incidental and shall be included in the bid price for other items of work for the project.

4.02 BID ITEMS:

- A. Special provisions, requirements, revisions to these Bid Items, and/or additional Bid Items, may be included in Section 01 01 00 (green pages) or on the Drawings or Details.
- B. Each manhole or dry well will be measured by the Engineer to the nearest one-tenth (0.10) of a foot, from invert at the centerline of manhole or from the floor of the dry well, vertically to the top of the frame. Drop connections will be measured vertically from invert to invert.

C. Standard Manhole

1. Includes all earthwork, furnishing and installing pre-cast sections, cover (unless a separate Bid Item is provided for furnishing ring and cover), pipe connections and channeling (including interior drops). Standard manhole depth shall be considered ten (10) feet.
2. Payment shall be made on a per each (EA.) basis.

D. Shallow Manhole

1. Shall be complete compensation for all labor, material and equipment required for complete installation of shallow manholes as indicated in Detail Drawing No. 02563-2. Includes all earthwork, furnishing and installing pre-cast sections, frames and covers (unless a separate Bid Item is provided for furnishing frames and covers) and pipe connections per the Drawings.
2. Payment shall be made on a per each (EA.) basis.

E. Standard Dry Well

1. Includes excavation, bedding, backfilling, compaction, grouting, installing and furnishing ring and slotted cover (unless a separate Bid Item is provided for furnishing ring and slotted cover), pre-cast sections, pipe connections (if required), special backfill material and poly sheeting as well as any additional earthwork not included in other Bid Items. Standard dry well depth shall be considered 10 feet.
2. Payment shall be made on a per each (EA.) basis.

F. Extra Dry Well Depth

Involves furnishing and installing dry well depths in excess of 10 feet.

G. Watertight Frames and Covers

This Bid Item shall be complete compensation for the **Differential Cost Increase** between the standard MH frame and cover and the watertight MH frame and cover.

H. Wet Well

1. Includes excavation, bedding, backfilling, compaction, top slab, pipe connections, hopper bottom fillet, grouting and testing. It includes furnishing and installing hatches (specified elsewhere).
2. Payment shall be made on a per each (EA.) basis.

I. Exfiltration Manhole Testing

1. Includes performing exfiltration tests of those manholes installed by the Contractor and selected by the Engineer, in conformance with this specification.

2. Payment shall be made per each (EA.) manhole selected by the Engineer and actually tested.

J. Vacuum Manhole Testing

1. Includes performing vacuum tests of those manholes installed by the Contractor and selected by the Engineer, in conformance with this specification.
2. Payment shall be made per each (EA.) manhole selected by the Engineer and actually tested.

****END OF SECTION****

1.00 GENERAL

1.01 DESCRIPTION:

- A. The work included in this Section includes furnishing and placing grout to fill holes, grout around pipe sleeves, set anchor dowels and bolts, set pump bases and other miscellaneous items of construction as shown on the Drawings.
- B. Special provisions, requirements and/or revisions to this Specification and/or Bid Item(s) may be included in Section 01 01 00 (green pages) and/or on the Drawings or Details.

1.02 QUALITY ASSURANCE:

- A. The following publications form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.
 - 1. American Society for Testing and Materials (ASTM)
 - a. ASTM C-191 Test Method for Time of Setting of Hydraulic Cement by Vicat Needle
 - b. ASTM C-827 Test Method for Early Volume Change of Cementitious Mixtures
 - c. ASTM D-696 Test Method for Coefficient of Linear Thermal Expansion of Plastics

1.03 SUBMITTALS:

Submittals shall conform to Section 01 33 00 of these Specifications.

2.00 PRODUCTS

2.01 CEMENT BASED GROUT:

Grout for sealing holes or openings or setting pump bases shall be Five-Star Grout or approved equal non-metallic non-shrink grout as manufactured by U.S. Grout Corporation. The grout shall show no shrinkage under ASTM C-827 and must contain no expansive cements or metallic powders such as aluminum or iron filings. Grout shall consist of pre-measured prepackaged materials supplied by the manufacturer requiring only the addition of water. The manufacturer's instructions printed on the outside of each bag. Water utilized shall be potable. Grout shall exhibit no shrinkage (0.00%) and shall have a maximum expansion of 4.0 percent when tested in accordance with ASTM C-827. The grout shall have a minimum 28-day compressive strength of 5,000 psi when tested in accordance with ASTM C-109, and shall have a minimum initial set time of 60 minutes when tested in accordance with ASTM C-191.

2.02 EPOXY GROUT:

Epoxy grout utilized for anchoring bolts or dowels in existing concrete shall be a pourable, non-shrink epoxy grout containing 100 percent solids. The grout shall be Five Star Epoxy Grout, or approved equal. The epoxy grout system shall be supplied in units consisting of three components, all pre-measured and prepackaged. Resin components shall not contain any non-reactive dilutants. The mixed epoxy grout shall have a minimum working life of 45 minutes at 75°F. The grout shall have no shrinkage (0.00%) and a

maximum 4.0% expansion when tested in accordance with ASTM C-827, and have a 7-day compressive strength of 10,000 psi when tested in accordance with ASTM D-696, Method B.

2.03 EPOXY ADHESIVE:

Epoxy adhesives for bonding pipe or fresh plastic concrete to existing concrete surfaces shall be Sikadur Hi-Mod, as manufactured by Sika Corporation, or approved equal. Grout components shall be prepackaged, two component, ready for field mixing.

3.00 EXECUTION

3.01 CEMENT BASED GROUT:

- A. Grout shall be mixed in strict accordance with manufacturer's instructions and with a minimum of water. Concrete surface to which it will be applied shall be sandblasted and thoroughly cleaned with water. Concrete surface shall be saturated with water, but free of standing water. Grout shall be thoroughly consolidated in place and free of air voids. Grout surface shall be troweled to a smooth surface and blended with the surround concrete. Grout shall be struck smooth with the edges of pump base plates. Grout shall be cured with wet burlap for a minimum of five days.
- B. Where applicable, pump bases shall be set on anchor bolts that have been set in epoxy grout or cast in concrete floor. Pump bases shall be leveled with nuts on the bolts beneath base plates and set 1.5 inches above the concrete curb. The remaining open space beneath the plates shall then be grouted in place with cement based grout. Extreme care shall be utilized to make sure grout is firmly packed beneath all parts of base plates.

3.02 EPOXY GROUT:

All surfaces in contact with grout shall be thoroughly cleaned and completely dry. The grout shall be placed in strict accordance with the manufacturer's instructions. An application tube shall be utilized to pump the grout to the bottom of the annular space around bolts or dowels. The hole shall be filled from the bottom up and from one side to prevent entrapment of air bubbles. The finished surface shall be smooth.

3.03 EPOXY ADHESIVE:

The existing surface shall be sandblasted and thoroughly cleaned prior to application of the adhesive. The adhesive shall be supplied in neat form to the prepared surface. Fresh concrete shall be applied while the adhesive is still tacky. A 30-minute delay before pouring the fresh concrete shall be provided if recommended by the manufacturer.

4.00 MEASUREMENT AND PAYMENT

4.01 GENERAL:

- A. See Section 01 22 00 – Measurement and Payment for General Requirements. See Section 01 01 00 – Special Requirements/Bid Items for possible modifications to Standard Bid Items.
- B. If no specific bid item is provided, measurement and payment shall be considered incidental and shall be included in the bid price for other items of work for the project.

4.02 BID ITEMS:

- A. Special provisions, requirements, revisions to these Bid Items, and/or additional Bid Items, may be included in Section 01 01 00 (green pages) or on the Drawings or Details.
- B. Furnish and install grout in accordance with these Specifications.
- C. Payment shall be on a Lump Sum (L.S.) basis.

****END OF SECTION****

1.00 GENERAL

1.01 DESCRIPTION:

- A. The work included in this Section consists of furnishing, fabricating, installing and erecting miscellaneous metal fabrications as shown on the Drawings, and as specified herein.
- B. Special provisions, requirements and/or revisions to this Specification and/or Bid Item(s) may be included in Section 01 01 00 (green pages) and/or on the Drawings or Details.

1.02 QUALITY ASSURANCE:

A. Fabricators

Miscellaneous metal products proposed for incorporation into the work under this Section shall be fabricated by an established fabricator having not less than three years continuous experience in the fabrication of such products. All welding shall be performed by welders currently certified by the American Welding Society (AWS).

B. Codes

All design, fabrication, and erection of miscellaneous metal fabrications shall conform to the following, in addition to all local and state codes:

1. OSHA Safety and Health Standards
2. AISC Manual of Steel Construction
3. AISC Code of Standard Practice
4. AWS Code for Welding in Building Construction
5. NAMM for Bar Grating

1.03 SUBMITTALS:

A. General

Submittals shall conform to Section 01 33 00 of these Specifications. Submit a list of all products proposed for incorporation into work under this Section.

B. Shop Drawings

1. Submit shop drawings for all fabricated items required under this Section prior to manufacture. Show all shop and erection details, including overall dimensions, cuts, copes, connections, holes, fasteners, and welds. Base dimensional data on actual field measurements where connections interface with other materials required.
2. Indicate all welds, shop and field, by currently recommended symbols of the American Welding Society.
3. Submit grating layout showing individual piece dimension, cutouts, connections, holes, and fasters.

2.00 PRODUCTS

2.01 STEEL:

- A. Steel stock shall be new, clean and free from rust and pitting. Stock shall conform to ASTM A36 unless noted otherwise. Pipe shall conform to A53. Tubing shall conform to ASTM A500 Grade B.
- B. Galvanizing shall conform to ASTM A-123, A-386 and A-523.

2.02 ALUMINUM:

Aluminum shall conform to Alloy 6061-T6 unless noted otherwise. Coat all aluminum surfaces in contact with concrete or other metals with bituminous coating or coal tar epoxy.

2.03 STAINLESS STEEL:

Stainless steel bolts, bars, plate and shapes shall meet the requirements of AISI Type 304 or AISI Type 316 as specified. Unless otherwise specified, stainless steel shall be AISI Type 304.

2.04 ALUMINUM PIPE RAILING:

- A. Fabricated of 1-½-inch inside diameter (1.9" O.D.) aluminum pipe conforming to ASTM B-241.
- B. Alloy 6061-T6.
- C. Rail shall be Schedule 40 pipe and all posts shall be fabricated of Schedule 80 pipe.
- D. All connections shall be welded and ground smooth.
- E. On level runs, the top of the top rail shall be 42 inches above the floor. On stairway runs, the top of the top rail shall be no more than 34 inches or less than 30 inches to the surface of tread in line with face of riser at forward edge of tread.
- F. Suitable supports, sleeves and brackets shall be provided.

2.05 STEEL PIPE RAILING:

- A. Fabricated of 1-½-inch inside diameter (1.9" O.D.) steel pipe conforming to ASTM A53.
- B. Railing shall be hot dip galvanized after fabrication.
- C. Rail shall be Schedule 40 pipe and all posts shall be fabricated of Schedule 80 pipe.
- D. All connections shall be welded and ground smooth.
- E. On level runs, the top of the top rail shall be 42 inches above the floor. On stairway runs, the top of the top rail shall be no more than 34 inches or less than 30 inches to the surface of tread in line with face of riser at forward edge of tread.

F. Suitable supports, sleeves and brackets shall be provided.

2.06 ALUMINUM GRATING AND STAIR TREADS:

A. Aluminum grating shall be pressure or swale locked and banded in conformance with ASTM B-221 & Federal Specification RR-G-661, except that the bars shall have a minimum 1-1/2-inch bar depth and minimum 3/16-inch bar thickness. See plan for required sizes. Stair treads shall have Type-B checkered plate nosing.

B. Grating type standard with a manufacturer normally engaged in making grating.

C. All grating supported on steel angle frames anchored to the structure unless otherwise specified.

D. Frames and supports shall be L 2" x 2" x 3/16" minimum size. Bolts shall be stainless steel.

E. Fasteners shall not project above the working surface.

2.07 LADDERS:

A. Fabricate from aluminum.

B. Fabricate to comply with OSHA requirements.

C. Provide cage or safety climbing devices where required by heights or where illustrated or noted.

D. Provide anchors and connections compatible with structural attachment surface, corrosion resistant and permanently sound not subject to loosening or pullout.

2.08 OPENINGS:

A. Provide metal components at openings with structural steel shapes as indicated. Threshold angles and jamb channels shall be galvanized.

B. Provide anchors as indicated.

2.09 ANCHORS:

A. All anchors and other type members to be embedded in the concrete shall be galvanized after fabrication if pieces are fabricated. All bolts and anchor bolts which are submerged in the splash zone or exposed to weather shall be stainless steel.

B. Standard bolts and nuts – ASTM A307 or A316.

C. High strength bolts and nuts for all structural joints – ASTM A325.

D. Anchor bolts – ASTM A307 or A316.

3.00 **EXECUTION**

3.01 **FABRICATION:**

A. **General**

1. Fabricate all metal work as shown on the Drawings and as specified herein. Weld all shop connections unless otherwise noted. Fabricate units in as large parts and sections as is possible.
2. Fabrication shall conform to accepted shop practices. Fabricate items with accurate cutting, drilling, and fitting. Provide all bolts, nuts, washers, and other fastening devices required for fastening and anchoring work.

B. **Welding**

Use electric shielded-arc process in accordance with Welding Specifications of American Welding Society. Use only welding operators properly trained and highly skilled in arc welding. Minimum fillet weld size shall be 3/16”.

C. **Galvanizing**

All steel items shall be surface prepared and hot dipped galvanized after fabrication in accordance with ASTM A123. Fabricate units complete or in largest practical sections before galvanizing. Field repairs to galvanizing shall be made using Galvinox, Galvo-Weld, or approved equal.

D. **Grating**

1. Fabricate complete with edge banding, cutouts, supporting beams, angle frames with welded-on anchors and j-bolts or saddle slips. Fabricate in sections. Maximum weight is 50 pounds for removable sections and 150 pounds for fixed sections.
2. Provide hold-down anchors of saddle slips of j-bolts to prevent accidental displacement and a safety hazard unless otherwise required.

3.02 **INSTALLATION:**

A. **General**

Accurately install all items in proper location plumb and level. Bolt and/or field weld together components as required. Install with allowance for expansion and contraction. Do not proceed with installation in areas of discrepancy until such discrepancies have been fully resolved. Protect the finish from scratches, nicks and dents during installation.

B. **Grating and Treads**

Anchor to supports with approved fastening devices. Top of grating and supports set flush with adjacent surface. Grating and/or treads shall be installed in accordance with the manufacturer's recommendations.

C. Grouting

After all structural members have been properly positioned and all bolts and anchor bolts tightened, pack mortar between concrete or masonry-bearing surfaces. Finish exposed surfaces flush and smooth.

4.00 MEASUREMENT AND PAYMENT

4.01 GENERAL:

- A. See Section 01 22 00 – Measurement and Payment for General Requirements. See Section 01 01 00 – Special Requirements/Bid Items for possible modifications to Standard Bid Items.
- B. If no specific bid item is provided, measurement and payment shall be considered incidental and shall be included in the bid price for other items of work for the project.

4.02 BID ITEMS:

- A. Special provisions, requirements, revisions to these Bid Items, and/or additional Bid Items, may be included in Section 01 01 00 (green pages) or on the Drawings or Details.
- B. Metal Fabrications
 - 1. Included shall be the furnishing and installation of all items as shown on the Drawings in conformance with these Specifications.
 - 2. Payment shall be on a Lump Sum (L.S.) basis.

****END OF SECTION****

1.00 GENERAL

1.01 DESCRIPTION OF WORK:

- A. The work included in this Section shall consist of furnishing all labor, materials, and equipment for the installation of non-welded aluminum guardrails and handrails.
- B. Railings as used in this section shall include handrails at stairways, and guardrails as required by the International Building Code and Washington Industrial Safety and Health Act (WISHA) regulations. All guardrails and handrails shall meet the requirements of the International Building Code (IBC), Section 1607.7.1, and OSHA. Guardrails and handrails as required by IBC and WISHA shall be furnished and installed at no additional cost whether or not they are explicitly shown on the Drawings.
- C. Special provisions, requirements and/or revisions to this Specification and/or Bid Item(s) may be included in Section 01 01 00 (green pages) and/or on the Drawings or Details.

1.02 REFERENCE CODES AND STANDARDS:

- A. International Building Code, current edition
- B. Washington Industrial Safety and Health Act of 1973
- C. State Building Code Act
- D. Washington State Barrier-Free regulations (WAC 51-30)

1.03 STRUCTURAL REQUIREMENTS:

Design handrails to withstand a 200 pound concentrated load applied horizontally or vertically at any point along the rail. Design guardrails to withstand a 50 pounds/foot uniformly distributed load applied horizontally at the top rail. Design intermediate rails to withstand a load of 50 pounds per linear foot applied horizontally along the rail. Design for the above loads or for the loads specified in Table 16-B of the International Building Code, whichever is greater.

1.04 DIMENSIONAL REQUIREMENTS:

- A. Where details are not shown, use Schedule 40 (minimum) pipe, 1-½” diameter. Guardrails shall be 42 inches high, and Handrails shall be 34 inches high as measured from the front top of the stair tread. Guardrails shall have a maximum post spacing of 5 feet; handrails 5 feet.
- B. Each guardrail is to be constructed with intermediate railings such that a 12” sphere cannot pass through any opening in the rail assembly, including the opening between the bottom rail and the solid surface to which the rail is attached. This requirement shall also apply to handrails where the height difference between the walking surface of the stair and surfaces below to which a person could fall exceeds 30 inches.
- C. A kickplate shall be attached continuously to the bottom of the guardrail assembly where required by OSHA regulations. The spacing between the kickplate and the solid surface beneath shall be

1/4" or the minimum required by OSHA regulations, whichever is less.

- D. Railings shall be smooth and free from defects or variations in finish which would cause scrapes or injury to persons brushing or sliding along the railing surface.
- E. Changes in direction shall be done with a radius corner, not a mitered corner. Minimum radius to centerline of pipe, 3".
- F. In long linear runs of railings, an expansion joint shall be provided at least every 50 feet of run to prevent buckling of railings.
- G. Adjust railing prior to anchoring to ensure matching alignment at butting joints. All bolts fastening guardrails are to be straight, and be placed so that they are perpendicular to the substrate surface.
- H. Substitutions

1.05 SUBMITTALS:

- A. Submittals shall conform to Section 01 33 00 of the Specifications.
- B. Submit shop drawings and product data under provisions of Section 01 33 00.
- C. Indicate component details, materials, finishes, connection and joining methods, and the relationship to adjoining work.
- D. Submit manufacturer's installation instructions under provisions of Section 01 33 00.

1.06 DELIVERY, HANDLING, AND STORAGE:

- A. Deliver materials to the job site in good condition and properly protected against damage to finished surfaces.
- B. Store material in a location and in a manner to avoid damage. Stacking shall be done in a way which will prevent bending.
- C. Store material in a clean, dry location away from uncured concrete and masonry. Cover with waterproof paper, tarpaulin, or polyethylene sheeting in a manner that will permit circulation of air inside the covering.
- D. Keep handling on site to a minimum. Exercise particular care to avoid damage to finishes of material.

2.00 PRODUCTS

2.01 ACCEPTABLE PRODUCTS AND MANUFACTURERS:

- A. Connectorail System as manufactured by Julius Blum & Co., Carlstadt, New Jersey.

- B. Non-Welded Aluminum Pipe Railing System, Series 500, manufactured by Superior Aluminum Products, Russia, Ohio.
- C. Other manufacturers with similar products may be considered, to be pre-approved before bid.

2.02 MATERIALS AND FINISHES:

A. Aluminum

1. Drawn Pipe:

Alloy 6063-T832 or 6061-T6 with minimum yield strength of 35,000 psi and a minimum allowable stress in bending of 19,500 psi.

2. Solid Reinforcing Bars:

Alloy 6061-T6

3. Extruded Bars and Shapes:

Alloy 6063-T52, or 6061-T6.

4. Castings:

Almag 35

5. Finish:

Clear anodized (refer to NAAMM Metal Finishes Manual).

2.03 RAILING SYSTEM:

- A. Material shall conform to 2.02 A and be finished in accordance with 2.02 A.5.
- B. Railing system shall be permanently anchored except where shown as removable on the drawings.
- C. Rails and Posts:

Fabricate rails and posts from anodized aluminum, 6061-T6, 6063-T832 or other alloy pipe with nominal size of 1-½” inches (1.900 inches outside diameter), Schedule 40 (0.145 inch wall, minimum). Provide post reinforcement consisting of solid aluminum reinforcing bar if required to meet structural requirements specified above.

D. Fittings:

Fittings shall be of wrought material of aluminum. Tee-fittings and elbows which are fabricated from more than one piece shall be of welded construction with no weld marks visible when the fitting is installed.

E. Connector Sleeves:

Internal connector sleeves shall be of extruded aluminum.

F. Mounting Flanges:

1. Floor flanges shall be of cast aluminum.
2. Heavy duty floor flange shall be of cast aluminum with a solid aluminum reinforcing bar.
3. Facia flanges shall be of aluminum with a solid aluminum reinforcing bar.

G. Toe Board:

Toe Board shall be of extruded aluminum; equal to BLUM No. 6446.

2.04 FASTENERS:

- A. Mechanical fasteners are to be provided as required by the manufacturer. All fasteners shall be either aluminum or stainless steel.
- B. Machine screws used to mount flanges to stair stringers shall be of stainless steel, 3/8-inch diameter.
- C. Adhesive to be Scotch-Weld epoxy adhesive, Catalog No 3M EC-2216 B/A Clear Amber, or approved equal.
- D. Cement Hydraulic, ASTM C 595, factory prepared with accelerator.

2.05 HANDRAIL BRACKETS:

Aluminum extruded equal to BLUM No. 498.

2.06 FABRICATION:

- A. Form rail-to-end post connections and all changes in rail direction by radius elbows.
- B. Cut material square and remove burrs from all exposed edges, with no chamfer.
- C. Make exposed joints butt tight and flush.
- D. Close exposed ends of pipe by use of appropriate end cap.
- E. Locate intermediate rails as shown on the drawings.
- F. Verify dimensions on site prior to shop fabrication.

3.00 EXECUTION

3.01 DISSIMILAR METALS:

- A. When aluminum components come into contact with dissimilar metals, surfaces shall be kept from direct contact by painting the dissimilar metal with a heavy coat of a proper primer.
- B. When aluminum components come into contact with cement or lime mortar, exposed aluminum surfaces shall be painted with heavy bodied bituminous paint.

3.02 INSTALLATION:

- A. Install in accordance with shop drawings and manufacturer's instructions.
- B. Erect work square and level, horizontal or parallel to rake of steps or ramp, and free from distortion or defects detrimental to appearance or performance.
- C. Expansion joints shall be provided as needed to allow for thermal expansion or contraction.

3.03 CLEANING:

- A. As installation is completed, wash thoroughly using clean water and soap; rinse with clean water.
- B. Do not use acid solution, steel wool or other harsh abrasives.
- C. If stain remains after washing, remove finish and restore in accordance with NAAMM Metal Finishes Manual. Finish must be removed from anodized aluminum. Reanodizing can only be done by removing railing and returning it to the anodizer.

3.04 REPAIR OF DEFECTIVE WORK:

Remove stained or otherwise defective work and replace with material that meets specification requirements.

4.00 MEASUREMENT AND PAYMENT

4.01 GENERAL

- A. See Section 01 22 00 – Measurement and Payment for General Requirements. See Section 01 01 00 – Special Requirements/Bid Items for possible modifications to Standard Bid Items.
- B. If no specific bid item is provided, measurement and payment shall be considered incidental and shall be included in the bid price for other items of work for the project.

4.02 BID ITEMS:

- A. Special provisions, requirements, revisions to these Bid Items, and/or additional Bid Items, may be included in Section 01 01 00 (green pages) or on the Drawings or Details.

B. Aluminum Handrail

Included shall be furnishing and installing of all materials in conformance with these specifications. Payment shall be on a Lump Sum (L.S.) basis.

****END OF SECTION****

1.00 GENERAL

1.01 DESCRIPTION:

- A. Furnish and install all wood used in rough carpentry and miscellaneous assemblies such as studs, rafters, joists, blocking, plates, nailers, trim, etc., as required by the Contract Documents, and shall also include shims, nailing of materials, securing of mechanical, electrical and hardware items, and any carpentry required for proper construction of the project.
- B. Special provisions, requirements and/or revisions to this Specification and/or Bid Item(s) may be included in Section 01 01 00 (green pages) and/or on the Drawings or Details.

1.02 CODES AND STANDARDS:

Rough carpentry shall conform to International Building Code (IBC) and other referenced codes and standards of governing authorities. In case of conflict between any codes and standards and this Section, the more stringent shall govern.

1.03 SUBMITTALS:

- A. Submittals shall conform to Section 01 33 00 of the Specifications.
- B. Manufacturers' catalog cuts showing rough hardware conforming to or equivalent to hardware shown shall be submitted to the Engineer for review.
- C. Shop Drawings and Certificates of Compliance shall be submitted wherever specifically called for herein.

2.00 PRODUCTS

2.01 LUMBER:

- A. All lumber, unless otherwise noted, shall be legibly trade- and grade-marked, kiln-dried S4S, Douglas Fir/Larch conforming to the Western Wood Products Association grading rules and IBC. Moisture content of lumber shall be 16 percent or less at time of installation.
- B. Trim:

Where shown on drawings and/or specified herein use clear cedar or redwood, trim quality, free of knots, splits or other imperfections.

2.02 PLYWOOD:

All plywood, unless otherwise noted, shall be identified with grade marks of the American Plywood Association (APA) and shall meet the requirements of the U.S. Product Standard PS-183 for softwood plywood. All plywood shall be constructed with exterior glues. Plywood for roof sheathing shall be Exposure 1, CDX. Plywood at soffits shall be Exterior Exposure with veneer A on visible faces and C on

hidden faces. Plywood not exposed to view may be oriented strand particle board of the same thickness and structural rating as the plywood called out on the drawings.

2.03 ROUGH HARDWARE:

The term “rough hardware” includes bolts, nails, lag screws, washers, plates, and similar items employed in erection and construction of rough work. Bolt anchorages embedded in concrete shall be provided as shown and required to complete work, including installation of such items furnished under other Sections of these Specifications. Standard product rough hardware shall be of standard manufacture approved by a recognized agency for loads as shown. Hardware shall be steel of thickness shown. Rough hardware shall be hot-dip galvanized after fabrication.

2.04 FASTENERS:

- A. Nails called out on the drawings are to be common wire nails unless otherwise specified or shown. Nails shall be galvanized or stainless steel as appropriate where exposed to weather or embedded in or in contact with preservative treated wood, exterior masonry or concrete walls or slabs. Nails used for exterior plywood (exposed to view) shall be stainless steel.
- B. Screws shall conform to IBC Standard 2304.9 and shall be galvanized where exposed to weather or embedded in or in contact with preservative treated wood, exterior masonry or concrete walls or slabs.
- C. Bolts and nuts shall conform to ASTM A307, sizes as indicated on Drawings, galvanized where exposed to weather.
- D. Plyclips shall be extruded 6063-T6 aluminum alloy.

2.05 TREATED LUMBER:

A. Kiln Drying

Kiln-dry lumber shall be treated with water-borne preservative and have a maximum moisture content of 15 percent after treatment.

B. Pressure Treated Lumber

All wooden nailing blocks, sills, and plates resting on or embedded in concrete or masonry within 18 inches of grade shall be pressure-treated in accordance with American Wood Preservers' Association Manual of Recommended Practice. Preservatives shall conform to those specified in the standard. Each piece of treated lumber shall have approval mark of approved testing agency. Creosote shall not be used. Pressure treated wood used to form a thermal break shall be wood approved for ground contact, 0.40 pretension level, LP-22 industry designation, IBC 2303.1.8.

C. Preservative

Two (2) thorough coats of preservative, Zehrunge "Pentaseal", Sherwin Williams "Kemwood Penta", or approved equal, shall be applied at least 2 hours before installation of all surfaces of ground, stripping, and other members which come in contact with or are set close to concrete and masonry, except lumber specified to be pressure-treated. Tank dipping or pressure-treating may be used.

D. Cuts

Wherever necessary to cut, notch, dap drill, or frame treated lumber, newly cut or bored surfaces shall be treated with two (2) heavy coats of the same preservative used in original treatment, minimum 1/4-inch depth of penetration.

3.00 EXECUTION

3.01 CARPENTRY:

A. Framing

Framing members and assemblies shall be set accurately to required lines and level, and to arrangements shown. Framing shall be accurately and neatly cut and strongly nailed, spiked, or otherwise secured in place in a workmanlike manner. Use joist hangers or framing clips at all joist or rafter connections to other framing members. Structural wood framing members shall not be spliced between bearing points or supports. Double wood framing members shall be used adjacent to openings and triple framing members at corners and intersections. All framing members that abut concrete or masonry shall be pressure treated and anchored with 3/8-inch bolts not more than 3 feet apart, unless noted otherwise. Approval shall be secured from the Engineer before cutting of any wood members that may weaken structure. All blocking and backing in walls and ceilings shall be 2 x material with depth as needed and shall be accurately located around light fixtures, ceiling registers, grilles, and other required mechanical and electrical items. Backing shall be accurately located and installed for all building specialties and finish hardware items as required. Due care shall be exercised in placing framing so that structural and other important members do not require cutting for openings, pipes, vents, conduits, or ducts. Bearing surfaces on which wood structural member are to rest shall be finished to give full, true, and even support. Wedges or shims shall not be used to correct faulty work. Wood members which have been split or otherwise damaged to such an extent as to materially impair their strength shall be removed and replaced at no additional cost to the Owner.

B. Nailing

Nails shall not be driven closer together than half their length unless driven in drilled holes, nor closer to edge of member than one-quarter of its length. Holes drilled slightly smaller than nail diameters shall be used when necessary to prevent splitting. The nails shall penetrate second or farther member not less than half of the length of nail. Common nails shall be used unless otherwise specified or shown. Staples may be used to fasten plywood to framing provided Contractor has previously provided the Engineer with product data showing that the stapling proposed will be structurally equivalent to the nailing called for.

C. Bolts and Nuts

Malleable or cut steel washers shall be provided under heads and nuts except where bearing on steel plates or other steel attachments, or where flat-head countersunk bolts are shown. Members shall be clamped together and bore holes shall be the same diameter as bolts, true to line. Bolts shall be driven in place and nuts drawn up tightly. Bolts shall be drawn tight again immediately prior to enclosing with finish or, if left exposed, upon completion of other work. Holes at anchor bolts embedded in concrete may be 1/8-inch larger than bolt diameter.

D. Screws

Lag and wood screws shall be screwed (not driven) into pre-drilled pilot holes. Pilot holes shall be bored first of the same diameter and depth as shank, then continued to depth equal to length of screw with diameter equal to base of the thread. Screws shall penetrate a distance equal to at least seven (7) times the diameter of the screw shank into far members. Washers shall be installed under each lag screw head bearing on wood.

E. Rafters

Rafters shall be placed with crown up and supported firmly on framing below. Care shall be used in selection and placing of members and positive and secure attachment shall be provided. The Contractor shall provide double joists and double headers to receive trimmers at openings which cut or interrupt normal rafter spacing.

F. Plywood Sheathing

Plywood sheathing shall be installed with face grain across supports, end joints over joists and staggered, and blocking, if shown, shall be provided at unsupported edges. Arrange panels to avoid widths less than 2'-0".

G. Trim

At top of CMU walls, interior and exterior, and elsewhere as shown on drawings-install 3/4" x 1-1/2" cedar or redwood trim, scribed to fit contact surfaces. Install with aluminum nails of appropriate size, 16" o.c. maximum spacing.

4.00 MEASUREMENT AND PAYMENT

4.01 GENERAL:

- A. See Section 01 22 00 – Measurement and Payment for General Requirements. See Section 01 01 00 – Special Requirements/Bid Items for possible modifications to Standard Bid Items.
- B. If no specific bid item is provided, measurement and payment shall be considered incidental and shall be included in the bid price for other items of work for the project.

4.02 BID ITEMS:

- A. Special provisions, requirements, revisions to these Bid Items, and/or additional Bid Items, may be included in Section 01 01 00 (green pages) or on the Drawings or Details.
- B. Included shall be furnishing and installing all required materials.
- C. Payment shall be on a Lump Sum (L.S.) basis.

****END OF SECTION****

1.00 GENERAL

1.01 DESCRIPTION OF WORK:

- A. The work covered by this Section consists of furnishing and installing finish carpentry items as shown on the Drawings and as specified herein.
- B. Special provisions, requirements and/or revisions to this Specification and/or Bid Item(s) may be included in Section 01 01 00 (green pages) and/or on the Drawings or Details.

1.02 REFERENCE STANDARDS:

- A. Architectural Woodwork Quality Standards and Quality Certification Program (AWI Quality Standards).
- B. WCLIB No. 17, WWPA-70, PS 1-66, and AWWA Standards as referenced in Section 06100.
- C. Voluntary Product Standard PS-51-71, "Hardware and Decorative Plywood", by U.S. Department of Commerce NBS.

1.03 DELIVERY, HANDLING, AND STORAGE:

Deliver materials at specified moisture content. Do not deliver finish wood to job until adequate storage is available. Protect material from moisture damage during delivery and storage.

2.00 PRODUCTS

2.01 MATERIALS:

- A. Lumber shall be grade-marked according to WCLIB No. 17 except as otherwise specified. Provide lumber dried to maximum moisture content of 16%, unless otherwise specified. Grading requirements not covered by WCLIB or WWPA shall be in accordance with U.S. Department of Commerce PS 20-70 and/or National Grading Rule for Softwood Dimension Lumber. All lumber shall be grade-marked. Provide West Coast Douglas Fir lumber except as otherwise specified below.
- B. Lumber for finish carpentry shall be softwood conforming to AWI Custom Grade as indicated in Section 100 of AWI Standard, and shall be Douglas Fir, cut and selected for vertical grain on exposed surfaces, kiln-dried at from nine to twelve percent moisture for exterior work suitable to receive specified paint.
- C. Plywood shall conform to AWI Section 200, with size as shown on Drawings and specified in Section 06 10 00.

3.00 EXECUTION

3.01 INSPECTION AND PREPARATION:

- A. Examine and coordinate related work and adjacent surfaces prior to starting work of this Section. Commencing finished carpentry work in each location constitutes acceptance of condition of substrates and materials.
- B. Prime in accordance with Section 09 90 00.

3.02 INSTALLATION:

Unless specifically indicated otherwise, finish carpentry shall not be set until contiguous construction is thoroughly dry.

4.00 MEASUREMENT AND PAYMENT

4.01 GENERAL:

- A. See Section 01 22 00 – Measurement and Payment for General Requirements. See Section 01 01 00 – Special Requirements/Bid Items for possible modifications to Standard Bid Items.
- B. If no specific bid item is provided, measurement and payment shall be considered incidental and shall be included in the bid price for other items of work for the project.

4.02 BID ITEMS:

Special provisions, requirements, revisions to these Bid Items, and/or additional Bid Items, may be included in Section 01 01 00 (green pages) or on the Drawings or Details.

****END OF SECTION****

1.00 GENERAL

1.01 DESCRIPTION:

- A. Work for this Section shall include designing, furnishing and installing Simple Saver System, or approved equal, and all building thermal and moisture barriers for a new metal building specified herein. System shall include insulation, vapor barriers, hangers, appurtenances, caulking, etc. and generally shall insulate and seal the entire new metal building structure. Insulating system shall have a continuous vapor barrier inside of building purlins, girts, and insulation to provide complete isolation from inside conditioned air.
- B. Special provisions, requirements and/or revisions to this Specification and/or Bid Item(s) may be included in Section 01 01 00 (green pages) and/or on the Drawings or Details.

1.02 QUALITY ASSURANCE:

- A. All materials shall be new and shall apply with all applicable codes.
- B. Manufacturer Qualifications: Company specializing in manufacturing product systems specified in this section with minimum five years documented experience.
- C. Installer Qualifications: Company specializing in performing work of this section.
- D. Insulation system components to include a ten-year limited material warranty.

1.03 SUBMITTALS:

- A. Submit complete manufacturer's literature and samples to the Engineer in accordance with the provisions of Section 01 33 00 of these Contract Documents for all materials proposed to be furnished and installed under this Section.
- E. Manufacturer's data sheets on each product to be used, shall at a minimum include:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation instructions.
- F. Shop Drawings: Indicate locations of connections and attachments, general details, anchorages and method of anchorage and installation.
- G. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square or long, representing actual products required for this project.
- H. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.04 DELIVERY, STORAGE, AND HANDLING:

- A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store products indoors and protect from moisture, construction traffic, and damage.

1.05 PROJECT CONDITIONS:

Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

2.00 PRODUCTS

2.01 SIMPLE SAVER SYSTEM:

A. Manufacturers:

1. Acceptable Manufacturer: Thermal Design, Inc., Simple Saver System, Madison, NE 68748, or approved equal.
2. Request for substitution shall include documentation that the proposed substitution is equal for all items specified herein. Additionally request for substitution shall include documentation that the manufacturer of the proposed substitution is comparable to Thermal Design in both experience and quality and that the proposed system is equal to the Simple Saver System in both number of successful installations and quality.

B. Simple Saver System Materials:

Simple Saver System consists of Batt Insulation, Roof Insulation, Wall Insulation, Vapor Barrier Liner Fabric, Thermal Breaks, Straps, and other devices and components in a proprietary insulation system as follows:

1. Batt Insulation: ASTM C 991 Type 1; preformed formaldehyde-free glass fiber batt
2. Roof Insulation: Formaldehyde-free fiberglass batt or fiberglass blanket complying with ASTM C 991 Type 1 and ASTM E 84 with a thermal resistance and thickness as indicated on the drawings.
3. Wall Insulation: Formaldehyde-free fiberglass blanket or batt complying with ASTM C 991 Type 1, ASTM E 136 and ASTM E 84 with a thermal resistance and thickness as indicated on the drawings.
4. Vapor Barrier Liner Fabric: Syseal® type woven, reinforced, high-density polyethylene yarns coated on both sides with a continuous white or colored polyethylene coatings, as follows:
 - a. Product complies with ASTM C 1136, Types I through Type VI.
 - b. Perm rating: 0.02 for fabric and for seams in accordance with ASTM E 96.
 - c. Flame/Smoke Properties:
 - 1) 25/50 in accordance with ASTM E 84.

- 2) Self-extinguishes with field test using matches or butane lighter.
- d. Ultra violet radiation inhibitor to minimum UVMAX® rating of 8.
- e. Size and seaming: Manufactured in large custom pieces by extrusion welding from roll goods, and fabricated to substantially fit defined building area with minimum practicable job site sealing.
- f. Provide with factory double, extrusion welded seams. Stapled seams or heat-melted seams are not acceptable due to degradation of fabric.
- g. Factory-folded to allow for rapid installation.
- h. Color shall be selected by the Owner from the manufactures standard colors.
Manufacturer shall have min 5 colors available for section by Owner.
5. Vapor Barrier Lap Sealant: Solvent-based, Simple Saver polyethylene fabric adhesive.
6. Vapor Barrier Tape: Double-sided sealant tape 3/4 inch (19 mm) wide by 1/32 inch (.79 mm) thick.
7. Vapor Barrier Patch Tape: Single-sided, adhesive backed sealant tape 3 inches (76 mm) wide made from same material as Syseal® type liner fabric.
8. Straps:
 - a. 100 KSI minimum yield tempered, high-tensile-strength steel.
 - b. Size: Not less than 0.020 inch (0.50 mm) thick by 1 inch (25 mm) by continuous length.
 - c. Galvanized, primed, and painted to match specified finish color on the exposed side.
Color by owner from manufactures standard colors.
9. Fasteners:
 - a. For light gage steel: #12 by 3/4 (19 mm) inch plated Tek 2 type screws with sealing washer, painted to match specified color.
 - b. For heavy gage steel: #12 by 1-1/2 inch (38 mm) plated Tek 4 type screws with sealing washer, painted to match specified color.
 - c. For wood, concrete, other materials: As recommended by manufacturer.
10. Wall Insulation Hangers: Fast-R preformed rigid hangers, 32 inch (813 mm) long galvanized steel strips with barbed arrows every 8 inches (203 mm) along its length.

2.02 RIGID INSULATION:

Rigid insulation shall be Styrofoam SM, K=0.20, 2" total thickness unless otherwise shown on Drawings. Polystyrene bead boards shall not be accepted.

2.03 CONCRETE VAPOR BARRIER:

Vapor barrier at exterior surface of concrete foundation walls shall be Sonneborn Hydrocide Black damp-proofing, or Flintkote asphalt emulsion system with 7WO-03 coating, or equal. Vapor barrier under concrete floor slabs shall be 10 mil black polyethylene extruded on to both surfaces or reinforced paper, and shall conform to Federal Specification UU-B-790, Type I, Grades A, B, C Style 4.

2.04 CAULKING AND SEALANTS:

Refer to Section 07 92 00- Sealants and Caulking

3.00 EXECUTION

3.01 EXAMINATION:

- A. Verify that building structure including all bracing and any concealed building systems are completed and approved prior to installing liner system and insulation in the structure.
- B. Correct any unsatisfactory conditions before proceeding.
- C. Coordinate installation of the roofing with building insulation system and metal wall panels. The insulation system and metal siding and roofing system shall all be installed in accordance with manufacturer's recommendations.
- D. If conditions are the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 SIMPLE SAVER SYTEM INSTALLATION:

A. General:

- 1. Install pre-engineered building insulation system in accordance with manufacturer's installation instructions and the approved shop drawings.
- 2. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- 3. Install in exterior spaces without gaps or voids. Do not compress insulation.
- 4. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
- 5. Fit insulation tight in spaces and tight to exterior side of the sealed liner fabric and around mechanical and electrical services within plane of insulation.

B. Roof Insulation Installation:

1. Straps:
 - a. Cut straps to length and install in the pattern and spacings indicated on shop drawings.
 - b. Tension straps to required value.
2. Vapor Barrier Fabric:
 - a. Install vapor barrier fabric in large one-piece custom fabricated pieces to substantially fit defined building areas with minimum practicable job site sealing.
 - b. Position pre-folded fabric on the strap platform along one eave purlin.
 - c. Clamp the two bottom corners at the eave and also centered on the bay.
 - d. Pull the other end of the pleat-folded fabric across the building width on the strap platform, pausing only at the ridge to fasten the straps and fabric in position where plane of roof changes and to release temporary fasteners on the opposite ridge purlins.
 - e. Once positioned, install fasteners from the bottom side at each strap/purlins intersection.
 - f. Trim edges and seal along the rafters.
 - g. All seams must be completely sealed and stapled seams not acceptable.
3. Insulation:
 - a. Unpack, and shake to a thickness exceeding the specified thickness.
 - b. Ensure that cavities are filled completely with insulation.
 - c. Place on the vapor barrier liner fabric without voids or gaps.
 - d. Place top layer of insulation over and perpendicular to the purlins without voids or gaps, as roof sheathing is applied.
4. Seal vapor barrier fabric to the wall fabric and elsewhere as required to provide a continuous vapor barrier.

C. Wall Insulation Installation:

1. Insulation:
 - a. Install thermal break to exterior surface of girts as wall sheathing is applied.
 - b. Position and secure Fast-R hangers to girts on the inside face of the wall sheathing.

- c. Cut insulation to required lengths to fit vertically between girts.
 - d. Fluff the insulation to the full-specified thickness.
 - e. Neatly position in place and secure to Fast-R hangers.
 - f. Ensure that cavities are filled completely with insulation.
2. Vapor Barrier Fabric:
- a. Install vapor barrier fabric in large one-piece custom fabricated pieces to substantially fit defined building areas with minimum practicable job site sealing.
 - b. Apply the vapor barrier fabric by clamping it in position over eave strap and installing fasteners through the eave strap into each roof strap, permanently clamping the wall fabric between them.
 - c. Once in position, draw the vapor barrier fabric down over the column flanges to the base angle and install vertical straps along each column and 5 feet 0 inches on center, maximum, fastening to each girt to retain system permanently in place.
 - d. All seams must be completely sealed and stapled seams not acceptable.
3. Seal wall fabric to the roof fabric, to the base angle and up the columns to provide a continuous vapor barrier.
- D. Cleaning:
1. Clean dirt or exposed sealant from the exposed vapor barrier fabric.
 2. Remove scraps and debris from the site.
- E. Protection:
1. Protect system products until completion of installation.
 2. Repair or replace damaged products before completion of insulation system installation.
- 3.03 RIGID INSULATION INSTALLATION:
- Install all rigid insulation against foundation walls and interior walls as shown on the drawings.
- 3.04 CONCRETE VAPOR BARRIER INSTALLATION:
- A. Install polyethelene sheet under floor slabs to form a continuous barrier. Joints shall overlap 12” minimum.
 - B. Install damp-proofing on exterior face of footing walls from top of footing to 2” below finish grade in accordance with manufacturer’s instructions.

3.05 CAULKING AND SEALANTS:

Refer to Section 07 92 00- Sealants and Caulking.

4.00 MEASUREMENT AND PAYMENT

4.01 GENERAL:

- A. See Section 01 22 00 – Measurement and Payment for General Requirements. See Section 01 01 00 – Special Requirements/Bid Items for possible modifications to Standard Bid Items.
- B. If no specific bid item is provided, measurement and payment shall be considered incidental and shall be included in the bid price for other items of work for the project.

4.02 BID ITEMS:

Special provisions, requirements, revisions to these Bid Items, and/or additional Bid Items may be included in Section 01 01 00 (green pages) or on the Drawings or Details.

*** * END OF SECTION * ***

1.00 GENERAL

1.01 DESCRIPTION:

- A. The work covered under this section includes the furnishing and installation of metal standing seam roofing, roofing felt underlayment and accessories necessary for a complete waterproof metal roof. It also includes metal siding and trim as shown on the Drawings. Roofing panels, clips, closures, and other accessories shall be standard products of the same manufacturer.
- B. Special provisions, requirements and/or revisions to this Specification and/or Bid Item(s) may be included in Section 01 01 00 (green pages) and/or on the Drawings or Details.

1.02 QUALITY ASSURANCE:

A. Qualifications of Installers

For actual installation of work described in this Section, use only competent and skilled roofers completely familiar with the products and methods of installation.

B. Codes and Standards

In addition to complying with all pertinent codes and standards, comply with the manufacturer's recommendations.

1.03 SUBMITTALS:

- A. Submittals shall conform to Section 01 33 00 of the Specifications.

B. Samples

Submit a 12 inch long by full width section of a typical panel.

C. Color

Submit color selection for Owner's review and selection.

- D. Provide wind uplift and drag force calculations based on the IBC and local codes. Calculations required to be stamped by a licensed Professional Engineer of the State of Washington.

1.04 WARRANTY:

The warranty period shall be not less than 20 years from the date of Substantial Completion. The warranty shall provide that if within the warranty period the metal roofing system becomes non-watertight or shows evidence of corrosion, perforation, rupture or excess weathering due to deterioration of the roofing system resulting from defective materials, the repair or replacement of the defective materials and correction of the defective workmanship shall be the responsibility of the roofing system manufacturer.

2.00 PRODUCTS

2.01 METAL ROOFING:

- A. Metal roof and wall panels shall have continuous lengths up to manufacturer's standard longest lengths, with no joints or seams from ridge to eave and material shall conform to ASTM A653 with a nominal gauge of 24. Width of panels shall be not less than 12 inches. System for securing the roof covering to structural framing or sheathing shall be concealed clip fastening system with no fasteners penetrating the panels except at the ridge or eave, rakes, penetrations, and end laps. Snap together type systems shall have a capillary break and a positive side lap locking device. The seam shall include a continuous factory applied sealant when required by the manufacturer to withstand the wind loads specified.
- B. Panels shall have a factory-applied exterior color coating equivalent to Whittaker Corporation's Polyceram 3200 thermoset linear polyester-melamine system of primer and final coat of 1.0 mil dry film thickness. The interior surface of colored panels shall be coated with 0.15 mil primer and 0.35 mil off-white polyester coating. Color of panels shall be selected by the Owner. Roof panels shall have the manufacturer's standard warranty furnished the Owner in writing.

2.02 METAL SIDING AND TRIM:

Metal siding and trim for all purposes shall be of the same material as the roofing, as specified herein. Siding shall be of the same structural configuration as roofing. Trim for rake, eaves, corners, openings and ridge shall be of the same material and requirements as roofing.

2.03 SEALANTS AND CLOSURES:

Sealant for laps shall be per manufacturer's recommendation. Closures shall be preformed closed cell laminated polyethylene foam matching panel profile and capable of weather-tight seal.

2.04 FASTENERS:

Fasteners shall be self drilling and/or self tapping zinc plated screws.

2.05 UNDERLAYMENT:

Underlayment shall be type 30 (30 lbs. per square) asphalt saturated felt.

3.00 EXECUTION

3.01 INSTALLATION:

- A. Metal roof shall be installed according to the manufacturer's recommendations. Screws of 2-inch minimum length shall be used.
- B. Roof caps, siding, flashing, trim and all other accessories shall be installed per manufacturer's recommendations, and to provide a neat, workmanlike and weather-tight installation.
- C. There shall be no end laps on roof panels. Steel and translucent wall panels shall have all side and end laps and splices sealed with butyl mastic. There shall be no horizontal splices in wall panels

except at translucent panels and door. Openings for louvers shall be caulked to provide a weather-tight seal around frames. When completed, the entire building shall be completely weather-tight and prevent rodent or bird access to its interior.

- D. Minor scratches and chipping of paint shall be repaired and painted with similar paint of thickness and color to match original coating. Dents and holes in panels are cause for rejection and replacement of panels, unless use or field repair is specifically approved by the Engineer.
- E. All cut edges shall be painted to match the panels.

4.00 MEASUREMENT AND PAYMENT

4.01 GENERAL:

- A. See Section 01 22 00 – Measurement and Payment for General requirements. See Section 01 01 00 – Special Requirements/Bid Items for possible modifications to Standard Bid Items.
- B. If no specific bid item is provided, measurement and payment shall be considered incidental and shall be included in the bid price for other items of work for the project.

4.02 BID ITEMS:

- A. Special provisions, requirements, revisions to these Bid Items, and/or additional Bid Items, may be included in Section 01 01 00 (green pages) or on the Drawings or Details.
- B. Metal Standing Seam Roofing
 - 1. Included shall be furnishing and installing of all materials in conformance with these Specifications.
 - 2. Payment shall be on a Lump Sum (L.S.) basis.

****END OF SECTION****

1.00 GENERAL

1.01 DESCRIPTION OF WORK:

- A. Work consists of furnishing all labor, materials, and equipment for the installation of all sheet metal flashings as shown and specified herein.
- B. Special provisions, requirements and/or revisions to this Specification and/or Bid Item(s) may be included in Section 01 01 00 (green pages) and/or on the Drawings or Details.
- C. Work included:
 - 1. Counterflashing at vent pipes and fan housings.
 - 2. Ridge vents: Install continuous at gable ridges in all buildings.
 - 3. Soffit vents.
 - 4. Sheet metal flashing and trim.

1.02 REFERENCE STANDARDS:

- A. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA).
- B. Architectural Sheet Metal Manual. Copy available from: SMACNA, PO Box 3506, Washington, DC 20007.
 - 1. Where more than one figure, illustration, or method of construction, is shown in the Architectural Sheet Metal Manual and not specifically indicated in the contract drawings, use standard sheet metal manual system most nearly matching applicable contract document situation.

1.03 GUARANTEE:

The Contractor shall furnish, at no additional cost to the Owner, a guarantee of the water-tightness of the flashings for a period of 5 years after date of signing Certificate of Substantial Completion by the Owner. Guarantee is limited to repairs due to ordinary wear from the elements and/or due to faulty materials and workmanship.

1.04 SUBMITTALS:

- A. Submittals shall conform to Section 01 33 00 of the Specifications.
- B. Submit all materials to be used.
- C. Submit a color selection for aluminum soffit and flashing.

2.00 PRODUCTS

2.01 SHEET METAL FLASHING AND TRIM:

A. Zinc-coated Steel

Commercial quality with 0.20% copper. ASTM A 526 except ASTM A527 for lock-forming, G90 hot dip galvanized, mill phosphatized where indicated for painting; 24 gage thick except as otherwise indicated. The Contractor may, at his/her option, substitute Bethlehem Steel Corporation "Galvalume"; Armco "Zincgrip"; "Galvanneal"; or "Redicoat" and meeting ASTM A653 Grade A requirements for galvanized finish.

B. Fasteners

Same metal as flashing/sheet metal or other non-corrosive metal, as recommended by sheet manufacturer. Match finish of exposed heads with material being fastened.

C. Metal Accessories

Provide sheet metal clips, straps, anchoring devices and similar accessory units as required for installation of work; matching or compatible with material being installed; non-corrosive; size and gage required for performance.

D. Zinc Coated Steel Primer

Self-etching type, compatible with paint system specified in Section 09 90 00; shop applied.

E. Aluminum Soffit and Vent

Shall be Traditional Select Series by Alcoa Building Products or approved equal. The aluminum soffit shall have the following:

1. 12-inch wide profile non-ventilating panels 3/8-inch deep, with double 5-1/2-inch faces forming V-grooves at 6 inches on center
2. Thickness: nominal 0.019 inch
3. Interlocking edges and elongated nailing hems
4. Finish: corrosion-inhibiting primer and baked-on acrylic topcoat (color by Owner)
5. 12-inch wide ventilating panels to match non-ventilating panels
6. Manufacturer-recommended accessories including J-channels, general-purpose trim and fascia to match soffit.

F. Ridge Vents

To be equal to Alcoa "Vent-a-Ridge" of 0.019 aluminum.

3.00 EXECUTION

3.01 WORKMANSHIP – GENERAL:

Execute by skilled mechanics according to best methods known to craft. Lines, moldings, edges sharp and true, reinforced as required for stiffness. Allow for expansion and contraction. Joints and seams to be neatly formed and finished; leave surfaces free from waves and buckles. Make exterior work permanently weather-tight.

3.02 FLASHINGS:

- A. Use concealed fastenings where possible. Where necessary to expose nailing, use large-head nails with neoprene washer. Joints, unless otherwise detailed or specified, shall be made in the best manner in the custom of the trade.
- B. Install ridge vent in strict accordance with manufacturer's printed instructions.

3.03 INSTALLATION:

A. Lap cement

Sufficient quantities of cement shall be used to completely coat and fill the space between the adjoining pieces eliminating all voids. The excess on the finished exposed surfaces shall be removed using the manufacturer's recommendations. All openings and possible leakage points, whether specifically mentioned or not, shall be caulked using the lap cement to guarantee a watertight job.

B. Fastenings

Exposed nails and screws shall be set sufficiently tight to secure the piece but shall not be set with undue pressure causing dimples or waviness. Adequate provisions shall be made for the full expansion and contraction of the parts.

C. Special Sections and Miscellaneous Sheet Metal

Shall be installed as indicated or intended. Install all recommended accessories and flashing at the joints; all as detailed on the drawings, or as required.

D. Fabricated and Manufacturer's Items

Install all work as detailed on the drawings and in accordance with approved shop drawings and manufacturer's instructions.

E. Ridge Vents

Install ridge vents in strict accordance with manufacturer's printed instructions. Determine that final installation will exclude moisture.

F. Soffit and Soffit Vents

Install soffit and soffit vents in strict accordance with manufacturer's printed instructions.

3.04 CLEANUP AND PROTECTION:

After installation, all items shall be left in a clean condition. Sheet metal shall be protected from scratching and abrasion before and after erection.

4.00 MEASUREMENT AND PAYMENT

4.01 GENERAL:

- A. See Section 01 22 00 – Measurement and Payment for General Requirements. See Section 01 01 00 – Special Requirements/Bid Items for possible modifications to Standard Bid Items.
- B. If no specific bid item is provided, measurement and payment shall be considered incidental and shall be included in the bid price for other items of work for the project.

4.02 BID ITEMS:

Special provisions, requirements, revisions to these Bid Items, and/or additional Bid Items, may be included in Section 01 01 00 (green pages) or on the Drawings or Details.

****END OF SECTION****

1.00 GENERAL

1.01 DESCRIPTION OF WORK:

- A. Work consists of furnishing all labor, materials, and equipment for the complete installation of sealant and caulking as indicated on the drawings and specified herein. Work is primarily at perimeter of hollow metal door frames, interior and exterior, and windows, and other penetrations in outside walls of buildings.
- B. The required applications of sealants includes, but is not necessarily limited to, the following general locations:
 - 1. Joints between window frames, door frames, and other construction.
 - 2. Control, expansion, or slab joints.
- C. Special provisions, requirements and/or revisions to this Specification and/or Bid Item(s) may be included in Section 01 01 00 (green pages) and/or on the Drawings or Details.

1.02 SUBMITTALS:

- A. Submittals shall conform to Section 01 33 00 of the Specifications.
- B. Submit manufacturer's surface preparation and installation instructions.
- C. Submit samples of sealant colors.

2.00 PRODUCTS

2.01 MANUFACTURERS:

Name and addresses of manufacturers of products specified herein are as follows:

- 1. Dow Corning Corporation, Midland, Michigan.
- 2. General Electric Company, Silicone Products Division, Waterford, New York.
- 3. Pecora Corporation, Harleysville, Pennsylvania.
- 4. Sika Chemical Corporation, Lyndhurst, New Jersey.
- 5. Sonneborn Building Products Division, Contech, Minneapolis, Minnesota.
- 6. Tremco, Cleveland, Ohio.

2.02 SEALANT SYSTEMS:

A. Type 1: Vertical joints one inch or less in width

All caulked joints to be coated shall receive a thin film application on a Polyurethane based caulking material. Silicone is not paintable and requires the application of the silicone base caulk to be applied after the coating is complete. A "paintable" caulk is not rated for exterior use and should only be used in mild interior conditions.

1. Silicon rubber (nonsag).

- a. Silpruf Sealant: General Electric Company, Silicon Products Div., Waterford, New York.
- b. 790 Building Sealant: Dow Corning Corp., Midland, Michigan.
- c. 864 Architectural Silicone: Pecora Corp., Harleysville, Pennsylvania.

B. Type 2: Interior nonmoving joints

1. Silicone rubber (at wet interior areas)

2. 786 Mildew-Resistant Silicone Sealant: Dow Corning Corp., Midland, Michigan.

3. Sanitary Sealant: General Electric Company, Silicone Products Div., Waterford, New York.

2.03 ACCESSORIES:

A. Primer

Non-staining type, recommended by sealant manufacturer to suit application.

B. Joint cleaner

Non-corrosive and non-staining type, recommended by sealant manufacturer and compatible with joint substrates.

C. Joint filler

Round, opened or closed-cell, foam rod, as recommended by sealant manufacturer, diameter oversized 30% greater than the width of joint to be filled.

D. Bond breaker

Pressure-sensitive tape recommended by sealant manufacturer to suit application.

3.00 EXECUTION

3.01 INSPECTION:

- A. Verify that joint dimensions and physical and environmental conditions are acceptable to receive work of this section.
- B. Beginning of installation means acceptance.

3.02 PREPARATION:

- A. Clean, prepare, and size joints in accordance with manufacturer's instructions. Remove any loose materials and other foreign matter which might impair adhesion of sealant.
- B. Verify that joint substrates and release tapes are compatible with sealant.
- C. Examine joint dimensions and size materials to achieve required width/depth ratios.
- D. Use joint filler to achieve required joint depths, to allow sealants to perform properly.
- E. Where joints are more than 3/4-inch deep, install joint filler to within 1/2-inch of surface.
- F. Where joint is more than 1/2-inch deep, install joint filler to within 1/4-inch of surface.
- G. Where joint is less than 1/2-inch deep, apply bond breaker tape to bottom of joint to prevent adhesion of sealant to joint bottom.
- H. Prime or seal joint surfaces wherever recommended by the sealant manufacturer. Do not allow primer/sealer to spill or migrate onto adjoining surfaces.

3.03 INSTALLATION:

- A. Install sealant in accordance with manufacturer's instructions.
- B. Apply sealant within recommended temperature ranges. Consult manufacturer when sealant cannot be applied within recommended temperature ranges.
- C. Tool joints to be concave.
- D. Joints to be free of air pockets, foreign embedded matter, ridges, and sags.
- E. Install sealant before painting only if it is recommended as paintable by the sealant manufacturer; otherwise, do all sealing after painting is completed.

3.04 CLEANING:

Remove excess and spillage of compounds promptly as the work progresses. Clean the adjoining surfaces by whatever means may be necessary to eliminate evidence of spillage, without damage to the adjoining surfaces of finishes.

4.00 MEASUREMENT AND PAYMENT

4.01 GENERAL:

- A. See Section 01 22 00 – Measurement and Payment for General Requirements. See Section 01 01 00 – Special Requirements/Bid Items for possible modifications to Standard Bid Items.
- B. If no specific bid item is provided, measurement and payment shall be considered incidental and shall be included in the bid price for other items of work for the project.

4.02 BID ITEMS:

- A. Special provisions, requirements, revisions to these Bid Items, and/or additional Bid Items may be included in Section 01 01 00 (green pages) or on the Drawings or Details.
- B. Sealants and Caulking
 - 1. Included shall be furnishing and installing all materials of conformance with these Specifications.
 - 2. Payment shall be on a Lump Sum (L.S.) basis.

****END OF SECTION****

1.00 GENERAL

1.01 DESCRIPTION OF WORK:

- A. Work consists of furnishing all labor, materials, and equipment for the installation of hollow metal doors and frames, and relites, as shown on drawings.
- B. Work included
1. Standard, insulated core type pressed-steel hollow metal door; standard frames, unless otherwise detailed.
 2. Prepare doors and frames to receive hardware specified in Section 08710.
 3. Provide window kits in doors where indicated.
 4. Certain openings may require custom doors and frames. See elsewhere for details.
- C. Special provisions, requirements and/or revisions to this Specification and/or Bid Item(s) may be included in Section 01 01 00 (green pages) and/or on the Drawings or Details.

1.02 REFERENCE STANDARDS:

SDI-100 - Recommended Specifications: Standard Steel Doors and Frames of Steel Door Institute.

1.03 SUBMITTALS:

- A. Submittals shall conform to section 01 33 00 of the Specifications.
- B. Product data:
- Submit manufacturer's descriptive literature including installation instructions for all products specified herein.
- C. Shop drawings:
- Submit drawings for fabrication and installation of all hollow metal work.
1. Indicate general construction, configurations, jointing methods, conditions at openings reinforcements, and locations of louvers and cutouts for glass.
 2. Provide a schedule of doors and frames using same reference numbers for openings as those in contract documents, identifying their installation and location.

1.04 DELIVERY, STORAGE, AND HANDLING:

- A. Provide packaging such as cardboard or other containers, separators, banding, spreaders, and paper wrappings as required to completely protect all metal doors and frames during transportation and storage.

- B. Inspect hollow metal work upon delivery for damage. Minor damages may be repaired provided the finish items are equal in all respects to new work and acceptable to the Engineer.
- C. Store doors and frames at the building site under cover. Place units on minimum 4-inch high wood sills or on floors in a manner that will prevent rust and damage. Avoid the use of non-vented plastic or canvas shelters which could create a humidity chamber.

2.00 PRODUCTS

2.01 MATERIALS:

A. Steel Sheets

- 1. All hollow metal doors and frames on this project are to be electrolytically deposited zinc-iron alloy-coated (Galvanealed) after all fabrication has been completed.

B. Paint

All hollow metal doors and frames on this project are to be coated, after all fabrication is complete. See painting specification division for detailed information.

2.02 HOLLOW METAL DOORS:

A. General

1. Style

Flush, equivalent to Curries model 707.

2. Thickness

1-³/₄ inches, unless indicated otherwise.

3. Construction

Hollow, seamless (no visible seams or joints on exposed faces or stile edges); equivalent to Curries 707 Series, 18 ga., with polyurethane foam core. Doors shall be fabricated from hot dipped zinc coated steel, alloyed type. The coating weight shall meet or exceed the minimum requirements for coatings having 0.4 ounces per square foot. Thoroughly clean and chemically treat to insure maximum paint adhesion. Factory prime as specified in SDI / DOOR A250.8.

4. Reinforcement

Reinforce for hardware specified.

B. Glass

See Section 08 81 00 for material and installation. See drawings for glass type locations.

2.03 HOLLOW METAL FRAMES:

A. Type

Fully welded frames; corners mitered and reinforced, welds full depth and width of frame.

B. Mortar guard boxes

Minimum 22-gauge welded in place.

C. Door bumpers

1. Manufacturer's standard resilient type; removable for replacement.
2. Place minimum of three single bumpers on single-door frames. Space equally along strike jamb.

D. Hardware Reinforcement

1. Hinges:

Steel plate 3/16-inch thick by 1-1/2 inches wide by 6 inches longer than hinge, secured by not less than six spot welds.

2. Strike plate clips:

Steel plate 3/16-inch thick by 1-1/2 inches wide by 3 inches long.

3. Surface applied closers:

12 gauge steel sheet, size as required by template, secured by not less than six spot welds.

4. Concealed closers:

Removable access plate of thickness to match frame with 12 gauge steel sheet perimeter reinforcement of size and shape required. Provide mortar box over space to receive closer.

E. Jamb anchors

1. Wood stud construction

18 gauge galvanized steel sheet, U-shaped type to engage stud, welded to back of frame. Loose anchors are not acceptable. Provide a minimum of three anchors per jamb.

2. Concrete masonry

Minimum of three adjustable galvanized “tee” anchors per jamb. Install in course mortar as work progresses.

3. Cast-in-place concrete walls

Use cabinet type frames anchored to concrete as per manufacturers printed recommendations, using expansion bolts. Frames to be galvanized as per requirements herein for frames and doors.

F. Floor anchors

For each jamb which extends to floor, provide clip-type anchors formed of not less than 14 gauge galvanized steel sheet, welded to back of frame, with 2 holes to receive fasteners.

G. Spreader bars

Fabricate frames with removable spreader bars, tack-welded across bottoms of jambs and mullions. Touch up with field applied galvanizing treatment after removal.

3.00 EXECUTION

3.01 INSTALLATION:

Install doors and frames in accordance with SDI-100, except as amended in this Section.

- A. Install hollow metal frames plumb and square, in correct locations indicated on drawings and with a maximum diagonal distortion of 1/8-inch. Ensure frames are securely and rigidly anchored to adjacent construction. Grout all door frames full.
- B. Install hollow metal doors, plumb and square, and with maximum clearances as follows:
 - 1. Jambs and head: 3/32-inch.
 - 2. Meeting edges, pairs of doors: 1/8-inch.
 - 3. Bottom of door at carpet or threshold: 1/8-inch.
 - 4. Bottom of door where no carpet or threshold: 5/8-inch.
- C. Install hardware in accordance with Division 8.
- D. Install glass and glazing in doors in accordance with Division 8.

3.02 ADJUST AND CLEAN:

A. Galvanizing Touchup:

Immediately after erection, sand smooth any rusted or damaged areas of galvanized coating and apply galvanized repair.

B. Remove and replace defective work, including doors which are warped, bowed, dented, buckled, or otherwise unacceptable.

C. Final Adjustments:

1. Check and readjust operating finish hardware items just prior to final acceptance.

2. Leave work in complete and proper operating condition.

4.00 MEASUREMENT AND PAYMENT

4.01 GENERAL:

A. See Section 01 22 00 – Measurement and Payment for General Requirements. See Section 01 01 00 – Special Requirements/Bid Items for possible modifications to Standard Bid Items.

B. If no specific bid item is provided, measurement and payment shall be considered incidental and shall be included in the bid price for other items of work for the project.

4.02 BID ITEMS:

A. Special provisions, requirements, revisions to these Bid Items, and/or additional Bid Items, may be included in Section 01 01 00 (green pages) or on the Drawings or Details.

B. Included shall be furnishing and installing of all metal doors and frames as shown on the Drawings in conformance with the Specifications.

C. Payment shall be on a Lump Sum (L.S.) basis.

****END OF SECTION****

1.00 GENERAL

1.01 DESCRIPTION OF WORK:

- A. Work consists of providing all labor, materials, equipment and accessories for the complete installation of a Wayne-Dalton 800C Series rolling overhead door system, or approved equal, equipped with all components, accessories, appurtenances, etc. required for a complete installation in the opening shown on the drawings.
- B. Special provisions, requirements and/or revisions to this Specification and/or Bid Item(s) may be included in Section 01 01 00 (green pages) and/or on the Drawings or Details.

1.02 RELATED WORK:

- A. Opening preparation, miscellaneous or structural metal work.
- B. Refer to electrical drawings and/or Section 26 00 00 of these Specifications for additional information on electrical wiring, connections and controls as required where electrically operated doors are scheduled.
- C. Finish Painting

1.03 REFERENCE STANDARDS:

- A. Provide work manufactured by a single firm specializing in the production of this type of work.
- B. Reference Standards:
 - 1. ANSI/DASMA 108 American National Standards Institute Standard Method For Testing Sectional Garage Doors and Rolling Doors: Determination of Structural Performance Under Uniform Static Air Pressure Difference.
 - 2. ANSI/DASMA 203 American National Standards Institute Specifications for non-rated fire rolling doors published by Door & Access Systems Manufacturers Association International.
 - 3. ASTM A123 Zinc [hot-dipped galvanized] coatings on iron and steel products.
 - 4. ASTM A229 Steel wire, oil-tempered for mechanical springs.
 - 5. ASTM A-653-94 Steel sheet, zinc-coated [galvanized] by the hot-dipped process, commercial quality.
 - 6. ASTM E330 Structural performance of exterior windows, curtain walls, and doors by uniform static air pressure difference.
 - 7. ASTM E413-87 Sound transmission class acoustical performance value = 22.

1.04 QUALITY ASSURANCE:

Rolling doors and all accessories and components required for complete and secure installations shall be manufactured as a system from one manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING:

- A. Do not deliver to site until openings are ready for installation.
- B. Store products in manufacturer's unopened packaging with seals and labels intact until ready for installation.
- C. Store materials off the ground in a dry, warm, ventilated weathertight location.

1.06 SYSTEMS DESCRIPTION:

- A. Rolling Door: Type: Wayne-Dalton Model 800C or approved equal
- B. Mounting: steel jambs
- C. Operation: motor with chain hoist
- D. Material: Galvanized steel with polyester finish paint

1.07 SUBMITTALS:

- A. Submittals shall conform to Section 01 33 00 of the Specifications.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- C. Shop Drawings: Include detailed plans, elevations, details of framing members, anchoring methods, required clearances, hardware, and accessories. Include relationship with adjacent construction.
- D. LEED Submittals: Provide documentation of how the requirements of Credit will be met:
 - 1. List of proposed materials with recycled content. Indicate post-consumer recycled content and pre-consumer recycled content for each product having recycled content.
 - 2. Product data and certification letter indicating percentages by weight of post-consumer and pre-consumer recycled content for products having recycled content.
- E. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

- F. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) long, representing actual product, color, and patterns.
- G. Manufacturer's Certificates: Certify products meet or exceed specified requirements.
- H. Closeout Submittals: Provide manufacturer's maintenance instructions that include recommendations for periodic checking, adjustment and lubrication of components.
- I. For information only, submit manufacturer's specifications for fabrication, painting, and installation instructions for each type of overhead door being installed onsite.

1.08 SEQUENCING:

- A. Ensure that locating templates and other information required for installation of products of this section are furnished to affected trades in time to prevent interruption of construction progress.
- B. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.09 PROJECT CONDITIONS:

Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.10 WARRANTY:

Standard one year warranty against defects in material and workmanship.

2.00 PRODUCTS

Products will be Wayne Dalton Model 800C Insulated Rolling Service Doors or approved equal.

- A. Maximum Width: 42 feet
- B. Maximum Height: 30 feet
- C. ASTM E 413 Sound transmission class acoustical performance value = STC 22

2.01 CURTAIN:

Curtain shall be composed of interlocking #34 flat slats 22 gauge galvanized steel slats with 24 gauge back slats, roll-formed per ASTM standards. The area between the #14 exterior slat and the back slat shall be filled by polyurethane insulation, R-value of 6.7 (U = 0.15). Curtain designed to withstand a 20 PSF windload. Ends of alternate/continuous slats shall be fitted with metal endlocks/windlocks.

Bottom Bar shall consist of two equal steel angles, .121" minimum thickness, to stiffen curtain, with astragal. Angle shall be steel or stainless steel.

2.02 GUIDES:

Guides shall be roll-formed steel channel bolted to angle or structural grade, three angle assembly of steel to form a slot of sufficient depth to retain curtains in guides to achieve 20 PSF windload standard. Guides may be provided with integral windlock bars and removable bottom bar stops.

2.03 BRACKETS:

Brackets shall be of 3/16 minimum thick steel plates, with permanently sealed ball bearings. Designed to enclose ends of coil and provide support for counterbalance pipe at each end.

2.04 COUNTERBALANCE:

Curtain to be coiled on a pipe of sufficient size to carry door load with deflection not to exceed .033" per foot of door span and to be correctly balanced by helical springs, oil tempered torsion type. Cast iron barrel plugs shall be used to anchor springs to tension shaft and pipe.

2.05 HOOD:

Hood shall be minimum 24-gauge galvanized sheet metal, flanged at top for attachment to header and flanged at bottom to provide longitudinal stiffness. Hood shall enclose curtain coil and counterbalance mechanism. A flexible hood baffle is included.

2.06 FINISH:

Shop coat of rust inhibitive primer on non-galvanized surfaces and operating mechanisms. Guides and bracket plates shall be coated with a flat black prime paint. Curtain color shall be selected by the Owner. Contractor shall submit color chart for owner selection.

2.07 OPERATION:

Where applicable, provide operators complete with electric motor, steel chain and sprockets, pushbutton controls, limit switches, magnetic reversing contactor, and other accessories necessary for proper operation. Door shall be operated by means of motor operation with emergency operation chain hoist. Photo eye sensor to be installed at the bottom of door to stop and reverse the door when interrupted by an object during the closing cycle. The operator shall be so designed that the motor may be removed without disturbing the limit-switch timing and without affecting the emergency auxiliary operators. Electrical components shall be properly rated for use in the area of classification.

2.08 WEATHERSTRIPPING:

Doors shall include bottom astragal, surface guide weatherstrip, and internal hood baffle weatherstrip. Optional lintel brush weatherstrip available.

2.09 LOCKING:

Electric-motor operation doors shall lock through the operator gearing.

2.10 PERFORMANCE:

A. Wind Load

Service doors shall be designed and installed to withstand a minimum 20 PSF wind load and shall meet all national, state, and local codes.

B. Usage

Doors system shall be designed to withstand a minimum of 20,000 cycles.

3.00 EXECUTION

3.01 EXAMINATION:

- A. Do not begin installation until substrates have been properly prepared.
- B. Examine conditions of substrates, supports, and other conditions under which this work is to be performed.

3.02 PREPARATION:

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION:

- A. Install doors in accordance with manufacturer's instructions and standards. Installation shall be by an authorized manufacturer's representative.
- B. Install door complete with necessary hardware, jamb and head mold strips, anchors, inserts, hangers, and equipment supports in accordance with final shop drawings, manufacturers instructions, and as specified herein.
- C. Fit, align and adjust rolling door assembly's level and plumb for smooth operation.
- D. Upon completion of final installation, lubricate, test and adjust doors to operate easily, free from warp, twist or distortion and fitting for entire perimeter.

3.04 ADJUSTING:

- A. Test for proper operation and adjust as necessary to provide proper operation without binding or distortion.
- B. Adjust hardware and operating assemblies for smooth and noiseless operation.

3.05 CLEANING:

- A. Clean curtain and components using non-abrasive materials and methods recommended by manufacturer.
- B. Remove labels and visible markings.
- C. Touch-up, repair or replace damaged products before Substantial Completion.

3.06 **PROTECTION:**

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

4.00 **MEASUREMENT AND PAYMENT**

4.01 **GENERAL:**

- A. See Section 01 22 00 – Measurement and Payment for General Requirements. See Section 01 01 00 – Special Requirements/Bid Items for possible modifications to Standard Bid Items.
- B. If no specific bid item is provided, measurement and payment shall be considered incidental and shall be included in the bid price for other items of work for the project.

4.02 **BID ITEMS:**

Special provisions, requirements, revisions to these Bid Items, and/or additional Bid Items, may be included in Section 01 01 00 (green pages) or on the Drawings or Details.

**** END OF SECTION ****

1.00 GENERAL

1.01 DESCRIPTION OF WORK:

The work described in this Section includes furnishing and installing aluminum windows at locations shown on the plans.

1.02 QUALITY ASSURANCE:

Windows shall meet the Architectural Aluminum Manufacturer's Association (AAMA) Standards, as well as all applicable codes.

1.03 SUBMITTALS:

Submittals shall conform to Section 01 33 00 of these Specifications. Windows shall not be fabricated prior to approval of submittals.

2.00 PRODUCTS

2.01 MANUFACTURER:

Windows shall be as manufactured by Herzog, 4000 Series, or approved equal.

2.02 ALUMINUM WINDOW:

A. Windows shall have a thermal break.

B. Finish:

AA-M12C22A31 clear anodized finish.

C. Window Members:

Aluminum alloy 6063-T5.

D. Fastenings:

Aluminum alloy or stainless steel. No plated materials.

E. Construction:

Ventilator and frame to be mitered and reinforced with aluminum angle corner clip and mechanically staked or welded. Frame members to be one piece, continuous with no splices. Hairline joint, sealed with an elastomeric sealant.

2.03 GLAZING:

A. All windows shall be factory glazed. Glazing shall have 1" O.A. thickness, interior and exterior light 3/16" clear with an hermetically sealed 5/8" air space between. PPG, LOF, or approved equal.

B. Warranty:

Integrity of sealed air space to be warranted for a period of five years.

2.04 ACCESSORIES:

Provide all glazing beads, seals, hardware, anchors and accessories for complete weather-tight window installation and operation of all opening sash.

2.05 PERFORMANCE:

Windows shall meet or exceed the following:

1. Resistance to Air Infiltration: ANSI/AAMA 302.9 - 1977. Air infiltration shall not exceed 0.375 CFM per square foot of overall frame dimension.
2. Resistance to Water Infiltration: ANSI/AAMA 302.9 - 1977. There shall be no leakage with test pressure of 3.67 lbs. per square foot.
3. Performance under Uniform Loading: ANSI/AAMA 302.9 - 1977. Maximum deflection of any member shall not exceed 1/175 of its span and when the load is removed, there shall be no evidence of any permanent deformation or damage to any member when tested under a load of 27.5 PSF outward, 55 PSF inward for a period not less than 10 seconds. (Design wind velocity 100 mph.)

3.00 EXECUTION

3.01 PRE-INSTALLATION:

Verify all dimensions by taking field measurements; proper fit and attachment to adjoining work is required. Prior to installation, inspect all surfaces to which aluminum windows must be fitted. Report, in writing to Engineer, any conditions detrimental to work.

3.02 INSTALLATION:

- A. Install windows and accessories complete into prepared openings by an experienced window erection contractor in accordance with instructions furnished by the window manufacturer. They shall be set plumb and true, properly aligned and securely anchored, as shown on approved drawings, with ventilators correctly adjusted. Joints and mullions between connecting windows shall be made watertight with sealant supplied and applied by window erector. Standard clips, mullions and bolts shall be provided by window manufacturer, and masonry anchors shall be furnished by the window erector. All joints between windows and surrounding construction shall be carefully sealed with an approved joint sealant.
- B. Comply with FGMA standards and instructions of glass manufacturer to achieve airtight and watertight performance, and to minimize breakage.
- C. Protect glass from edge damage during handling and installation. Inspect glass during installation and discard pieces with edge damage that could affect glass performance. Protect glass from contact with contaminating substances resulting from construction operations; remove any such substance by

method approved by glass manufacturer.

3.03 ADJUST AND CLEAN:

Erector to adjust movable units to operate smoothly in compliance with manufacturer's instructions and to meet specified performance levels when closed. Hardware and moving parts shall be lubricated. Aluminum surfaces shall be cleaned and excess sealants removed by qualified window cleaner. Windows shall be left in a closed position to protect against dirt and the elements.

4.00 MEASUREMENT AND PAYMENT

4.01 GENERAL:

- A. See Section 01 22 00 - Measurement and Payment for General Requirements. See Section 01 01 00 - Special Requirements/Bid Items for possible modifications to Standard Bid Items.
- B. If no specific bid item is provided, measurement and payment shall be considered incidental and shall be included in the bid price for other items of work for the project.

4.02 BID ITEMS:

A. Windows

- 1. This Bid Item includes all work and materials required to furnish and install windows at locations shown on the plans.
- 2. Payment shall be on a Lump Sum (L.S.) basis.

****END OF SECTION****

1.00 GENERAL

1.01 DESCRIPTION:

- A. The work under this section of the specifications shall include the furnishing of all labor, material and equipment necessary to complete the furnishing and installation of all finish hardware as shown on the Drawings and specified herein. Any inadvertent error or omission in the listing below shall not waive the Contractor's responsibility to supply complete and proper hardware for all requirements.
- B. The Contractor shall be entirely responsible for coordination among all trades and all fabricators for proper preparation and installation.
- C. Special provisions, requirements and/or revisions to this Specification and/or Bid Item(s) may be included in Section 01 01 00 (green pages) and/or on the Drawings or Details.

1.02 QUALITY ASSURANCE:

- A. Single source responsibility: Obtain each type of hardware (latch and locksets, hinges, closers, etc.) from a single manufacturer.
- B. Brands and models designated in this Section are intended to define the exact standards of quality, function and design required. Products of other manufacturers may be substituted, providing they are equal in quality and design to the items specified and receive the express approval of the Engineer. No substitutions will be permitted after final approval of the hardware schedule by the Engineer.
- C. For actual installation, use only skilled journeyman carpenters who are completely familiar with the recommended methods of installation and the requirements of this work.

1.03 WARRANTY:

The hardware supplier shall provide to the Owner written warranties from the manufacturers of locksets for three years and door closers for a ten-year period.

1.04 SUBMITTALS:

- A. Submittals shall conform to Section 01 33 00 of the Specifications.
- B. The Contractor shall furnish a typewritten hardware schedule including photocopied catalog cuts of all proposed items of hardware, for the Engineer's review.
- C. The schedule is to be fully detailed with information as to brands, abbreviations, locations, hand and swing of doors, key-side of openings, keying, template, references, special instructions as needed for installation, and such other data as may be required by all parties involved. The Engineer's review of this schedule will not relieve the hardware supplier of responsibility to supply the job complete and in conformance with the entire specifications for this job.

1.05 DELIVERY, STORAGE, AND HANDLING:

- A. Package each item of hardware separately in individual containers, complete with screws, keys, special wrenches, instructions, and installation templates, necessary for accurately locating, setting, adjusting and attaching hardware. Mark each container with number of door to which hardware item is to be applied, and with item number corresponding with hardware item number listed in Contractor's hardware schedule. At the completion of the project, the Contractor shall turn over to the Owner all installation instructions, templates and adjusting tool. The loss of such instructions, templates, or tools shall be the responsibility of the Contractor.
- B. If physical delivery of hardware is required to a fabricator, such hardware is to be shipped in one complete lot by the hardware supplier, and notated copies of the hardware schedule forwarded to the fabricator and the Contractor.
- C. The hardware supplier shall furnish templates, schedules and any other pertinent information required to the door and frame manufacturer(s) within ten days after receipt of the approved finish hardware schedule.
- D. No hardware shall be ordered, or delivered to the job, until the reviewed schedule has been received from the Engineer. Review of the schedule does not relieve the hardware supplier of fulfilling all terms of the specifications.
- E. Each item of hardware delivered to the job must be new, in the manufacturer's original package, complete with all fastenings, and free from defects and must be properly marked for identification in accordance with the hardware schedule.

2.00 PRODUCTS

2.01 FINISH HARDWARE:

- A. Hardware not specifically listed in this Section, but shown on the Drawings, shall be included under this Section. Products shall be of number one quality. Unless otherwise specified, provide three silencers for each door.
- B. Unless otherwise specified or shown on the Drawings, locksets in same building shall be keyed same. Provide four (4) keys with each lockset. Engineer to approve key schedule.
- C. Hardware furnished shall be by the Manufacturers as indicated herein:
 - 1. Hinges: McKinney, Ives, Stanley
 - 2. Locks: Sargent, Schlage, Best
 - 3. Exit Devices: Sargent, Von Duprin, Stanley/Precision
 - 4. Closers: Sargent, LCN, Norton
 - 5. Flush bolts / trim: Rockwood, Ives, Trimco
 - 6. Thresholds / weather strip: Pemko, NGP, Zero

2.02 FINISHES AND STYLE:

- A. Unless specifically indicated, provide all architectural hardware in the following finishes:

1. BHMA 626 / 628 / 652 / 630 as indicated in hardware groups.
2. Provide BHMA 689 for closers.

3.00 EXECUTION

3.01 INSTALLATION:

- A. All hardware shall be installed by carpentry mechanics, skilled in the application of hardware. All instruction sheets and installation detailed, which are packed with the hardware, shall be read and understood before any attempt is made to install the hardware. Install hardware accurately fitted, securely applied, and carefully adjusted. Install in accordance with manufacturer" instructions. Use care not to injure other work when installing.
- B. Provide and use boring jigs, mortising tools and other special equipment and appliances as required for proper installation of hardware items.
- C. Door bottoms and tops shall be painted.
- D. Remove all visible hardware before painting is begun and replace afterwards, prior to completion of building. All exposed screws necessary for hardware attachment shall be stainless steel.
- E. All necessary hardware of equal quality and finish must be furnished for the proper fastening and operation of all movable parts whether or not specifically mentioned herein.
- F. After installation, all templates, instruction sheets, and installation details shall be placed in a file folder to be turned over to the Owner when the building is accepted.

4.00 MEASUREMENT AND PAYMENT

Finish hardware shall be incidental to Section 08 11 13 – Metal Doors and Frames.

****END OF SECTION****

1.00 GENERAL

1.01 DESCRIPTION OF WORK:

- A. Work consists of furnishing all labor, materials, and equipment for the installation of glass and glazing as shown on the drawings and specified herein.
- B. Work included:

Glass and glazing for exterior hollow metal doors, vinyl windows, mirrors, and relites.
- C. Special provisions, requirements and/or revisions to this Specification and/or Bid Item(s) may be included in section 01 01 00 (green pages) and/or on the Drawings or Details.

1.02 REFERENCE STANDARDS:

- A. Federal Specifications (FS)
 - 1. DD-G-1403B: Glass, Plate (Float), Sheet, Figured and Spandrel (Heat-Strengthened and Fully Tempered).
 - 2. DD-G-451D: Glass, Plate, Sheet, Figured (Float, Flat, for Glazing, Corrugated, Mirrors and Other Uses).
- B. Sealed Insulating Glass Manufacturers Associations (SIGMA)

SIGMA # 65-7-2 Specification for Sealed Insulating Glass Units.
- C. Consumer Protection Safety Committee (CPSC)

Standard 16CRF 1201.
- D. American National Standards Institute (ANSI)

ANSI Z97.1 – Safety Performance Specifications and Methods of Test for Safety Glazing Material Used in Buildings.
- E. Glass Association of North America (GANA)

1.03 QUALITY ASSURANCE:

- A. Installer's Qualifications

In accordance with the General and Special Conditions.

B. Allowable Tolerances

Thicknesses of glass specified are nominal. Provide glass manufactured to tolerances listed in GANA manual.

C. Warranty

Manufacturer's standard, but not less than five (5) years after date of Substantial Completion.

1.04 SUBMITTALS:

Submittals shall conform to Section 01 33 00 of the Specifications.

2.00 PRODUCTS

2.01 GLASS MATERIALS:

A. Polished plate or float glass (annealed), Type I, Class 1 (clear), quality Q3 glazing, Federal Specification FS-DD-G-451D. Thickness as shown on Drawings or listed below.

B. Safety glass

Kind, fully tempered; Condition A; Type I; Class 1 (clear); Quality Q3 glazing; Federal Specification FS-DD-G-1430B. Thickness as shown on Drawings or listed herein.

2.02 GLASS TYPES:

A. Type 1

Insulating glass, hermetically sealed double-glazed units. SIGMA #65-7-2. Outer pane Type 1 glass; inner pane Type 1 glass, maximum U-value of 0.30, minimum percent daylight transmittance of 72%; Milgard, Cardinal Low E-172 or equal.

B. Type 2

Sound Control Windows shall have a minimum STC of 36 and insulation requirements of Type 1, Milgard Bnz / Low E-172 or equal.

C. Type 3

1. Tinted Glass

Same as Type 1 with tinting; Milgard Bnz / Low E-172 or equal.

2. Door glass

Insulating glass shall be 5/8-inch thickness. Interior and exterior glass to be Class 1, quality Q-3 tempered to four times normal strength; 3/16 to 1/4-inch thick. Permanent mark on each piece of tempered glass.

D. Glass mirrors:

Glass shall be Type 1, Class 1, quality Q-2, 3/16-inch thick with a silver coating and copper backing conforming to FS-DD-M-00411. Two coats of a clear acrylic shall be applied over the copper backing and edges of the mirror.

2.03 GLAZING MATERIALS:

A. Sealants

Dow Corning No. 781, G.E. Series No. 1200, Tremco No. 440; color as selected by the Engineer.

B. Cleaners, sealers, primers, tapes

Types as recommended by manufacturer of product being installed for particular conditions of installation in each case.

C. Glazing accessories

Provide setting blocks, resilient spacer shims and other accessories required by referenced glazing standards.

D. Sound Control Windows shall have a minimum STC of 36, Milgard Bnz / Low E-172 or equal.

3.00 EXECUTION

3.01 WORKMANSHIP:

A. General

1. Comply with FGMA Glazing Manual and SIGMA except as specifically recommended by the glass and the glazing materials manufacturers.
2. Verify with sealant manufacturer and insulating glass manufacturer that the sealants are compatible with glass specified.
3. At exterior glazed openings of insulating glass verify that a minimum of three 3/16-inch diameter weep holes have been provided in window sill frames.
4. Protect glass from edge damage at all times during handling, installation, and subsequent operation of the glazed components of the work.
5. Inspect each piece of glass immediately before installation and discard pieces which have observable edge damage or face imperfections.

B. Preparation

1. Clean glazing channel, or other framing members to receive glass, immediately before glazing. Removed coatings which are not firmly bonded to the substrate. Removed lacquer from metal surfaces wherever elastomeric sealants are used.
2. Apply primer or sealer to joint surfaces wherever recommended by sealant manufacturer.

C. Cure and protection

1. Cure glazing sealants and compounds in compliance with manufacturer's instructions and recommendations, to obtain high early bond strength, internal cohesive strength and surface durability.
2. Protect glass and glazing sealants and compounds during the construction period, so that they will be without deterioration or damage at the time of Owner's acceptance.
3. Prevent glass damage due to welding and alkaline wash from uncured concrete surfaces and similar sources of possible damage.
4. Remove and replace glass which is broken, chipped, cracked, abraded or damaged in other ways during construction period.

3.02 GLASS INSTALLATION:

Install glass and glazing tapes and sealants in accordance with FGMA and SIGMA standard practices except as specifically modified and recommended by the glass and glazing material manufacturers.

3.03 CLEANING:

- A. Remove droppings from finished surfaces.
- B. Remove labels after work is completed.
- C. Maintain glass in a reasonably clean condition during construction so that it will not be damaged by corrosive action and will not contribute (by wash-off) to the deterioration of glazing materials and other work.

4.00 MEASUREMENT AND PAYMENT

4.01 GENERAL:

- A. See Section 01 22 00 – Measurement and Payment for General Requirements. See Section 01 01 00 – Special Requirements/Bid Items for possible modifications to Standard Bid Items.
- B. If no specific bid item is provided, measurement and payment shall be considered incidental and shall be included in the bid price for other items of work for the project.

4.02 BID ITEMS:

Special provisions, requirements, revisions to these Bid Items, and/or additional Bid Items, may be included in Section 01 01 00 (green pages) or on the Drawings or Details.

****END OF SECTION****

1.00 GENERAL

1.01 DESCRIPTION:

- A. The work included in this Section consists of the preparation and coating of all surfaces as shown on the Drawings and described herein except paints and coatings included in 09 96 00 High Performance Coatings.
- B. Special provisions, requirements and/or revisions to this Specification and/or Bid Item(s) may be included in Section 01 01 00 (green pages) and/or on the Drawings or Details.

1.02 QUALITY ASSURANCE:

A. Qualifications of Painters

Use only qualified journeyman painters for the mixing and application of paint on exposed surfaces; in the acceptance or rejection of installed painting, no allowance will be made for lack of skill on the part of painters.

All Contractors and subcontractors that perform surface preparation or coating applications on structural or fluid containing systems shall be certified by the Society for Protective Coating (SSPC) to the requirements of SSPC QP1 prior to Contract Award, and shall remain certified while accomplishing any surface preparation or coating application.

1.03 SUBMITTALS:

A. Materials List

1. Submittals shall conform to Section 01 33 00 of the Specifications.
2. Within 30 days after award of Contract, and before any paint material are delivered to the job site, submit to the Engineer a complete list of all materials proposed to be furnished and installed under this portion of the work.
3. This shall in no way be construed as permitting substitution of materials for those specified or approved for this work by the Engineer.

B. Samples

1. Accompanying the materials list, submit to the Engineer two copies of the full range of colors available in each of the proposed.
2. Upon direction of the Engineer, prepare and deliver to the Engineer two identical sets of samples of each of the selected colors and glosses painted onto 8-1/2-inch by 11-inch by 1/2-inch thick material; whenever possible, the material for the samples shall be the same material as that on which the coating will be applied in the work.

C. Manufacturer's Instructions

1. Mixing: submittal shall include detailed mixing instruction, minimum and maximum application temperature and humidity, potlife, and curing and drying times between coats.
2. SMDS: submit manufacturer's Material Safety Data Sheets for coatings, solvents, and other potentially hazardous materials, as defined in FED-STD-313.

D. Manufacturer's Recommendation

In each case where material proposed is not the material specified or specifically described as an acceptable alternate in this Section of these Specifications, submit for the Engineer's review, the current recommended method of application published by the manufacturer of the proposed material.

1.04 PRODUCT HANDLING:

A. Delivery

Deliver all paint and coating materials to the job site in sealed containers that legibly show the contract specification number, designation name, batch number, color, quantity, date of manufacture, manufacturer's formulation number, manufacturer's directions including any warnings and special precautions, and name and address of manufacturer. Paints, coatings and related materials shall be stored in accordance with the manufacturer's written directions.

B. Protection

1. Store only the approved materials at the job site, and store only in a suitable and designated area restricted to the storage of paint materials and related equipment.
2. Use all means necessary to ensure the safe storage and use of paint materials and the prompt and safe disposal of waste.
3. Use all means necessary to protect paint materials before, during, and after application and to protect the installed work and materials of all other trades.

C. Replacements

In the event of damage, immediately make all repairs and replacements necessary to the approval of the Engineer and at no additional cost to the Owner.

2.00 PRODUCTS

2.01 PAINT AND COATING MATERIALS:

A. Manufacturer

1. All materials selected for coating systems for each type of surface shall be the product of a single manufacturer.
2. Painting and Coating materials, unless otherwise designated in the "Coating Schedule", shall be one of the following:

- a. Koppers Company, Inc.
 - b. Tnemec Company, Inc.
 - c. Engard Coatings Corporation
 - d. Benjamin Moore
 - e. Sherwin Williams (S-W)
3. Equivalent products of other major manufacturers may be used subject to approval by the Engineer of the materials list and manufacturer's recommendation required to be submitted under Article 1.03 above.

B. Compatibility

1. All materials and equipment shall be compatible in use; finish coats shall be compatible with prime coats; prime coats shall be compatible with the surface to be coated; all tools and equipment shall be compatible with the coating to be applied.
2. Thinners, when used, shall be only those thinners recommended for that purpose by the manufacturer of the material to be thinned.

C. Colors and Glosses

All colors shall be as selected by the Engineer.

3.00 EXECUTION

3.01 SURFACE CONDITIONS:

A. Inspection

1. Prior to all work of this Section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.
2. Verify that finishes may be applied in strict accordance with all pertinent codes and regulations and the requirements of these Specifications.

B. Discrepancies

1. In the event of discrepancy, immediately notify the Engineer.
2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.02 PREPARATION OF SURFACES, GENERAL:

A. Protection

Prior to all surface preparation and painting operations, completely mask, remove, or otherwise adequately protect all hardware, accessories, machined surfaces, plates, lighting fixtures, and similar items in contact with painted surfaces but not scheduled to receive paint.

B. Cleaning

1. All surface preparation shall be in accordance with the coatings manufacturers' published recommendations
2. Before applying paint or other surface treatment, thoroughly clean all surfaces involved.
3. Schedule all cleaning and painting so that dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

3.03 PREPARATION OF METAL SURFACES:

A. Galvanized Metal Including Pipe

1. Clean all surfaces thoroughly with solvent until they are completely free from dirt, oil, and grease.
2. Thoroughly treat the cleaned surface with phosphoric acid etch (not required if paint-grip galvanizing is used).
3. Remove all excess etching solution and allow to dry completely before application of paint.

B. Other Metals

1. Thoroughly clean all surfaces until they are completely free from dirt, oil, and grease.
2. Allow to dry thoroughly before application of paint.

C. DI and CI Piping, Fittings, Valves and Appurtenances

Surfaces with factory applied epoxy prime coat shall be cleaned and prepared in accordance with the primer and topcoat manufacturer's recommendations.

Meters, valves and fittings with factory applied epoxy or enamel topcoat need not be coated in the field to match piping color.

Surfaces with factory applied bituminous coating shall be prepared with per NAPF 500-03-04/05 and not less than SSPC-SP7 "Brush-off blast cleaning". All factory applied exterior bituminous coating on cast/ductile iron shall be removed. Provide appropriate (per manufacturer) tiecoat" over pre-coated factory equipment to be painted.

3.04 PREPARATION OF PVC SURFACES

A. Piping, Fittings and Appurtenances

1. Thoroughly clean all surfaces until they are completely free from dirt, oil, and grease.
2. Prepare surfaces in accordance with coating and pipe manufacturer's recommendations.

3.05 PREPARATION OF WOOD SURFACES:

A. Cleaning

All wood surfaces shall be cleaned until they are free from dirt, oil, and all other foreign substances.

B. Smoothing

1. Unless specifically noted to be left rough, all finished wood surfaces exposed to view shall be smoothed, using the proper sandpaper.
2. Where so required, varying degrees of coarseness in sandpaper shall be used to produce uniformly smooth and unmarred wood surfaces.

C. Knots

The Contractor shall thoroughly scrape and clean the surface and apply one coat of good quality knot-sealer before application of the prime coat. He shall remove and treat all pitch surfaces as required for knots.

D. Dryness

Do not proceed with painting of wood surfaces until the moisture content of the wood is 12% or less.

3.06 PREPARATION OF MISCELLANEOUS SURFACES:

A. Gypsum Wallboard

The Contractor shall fill all holes and cracks and sand all taped joints to a smooth, even finish.

B. Concrete and Masonry

Complete all caulking, painting or restoration work before commencing application. Prepare surfaces to be sealed of all oil, grease, and efflorescence, in conformance with the latest version of SSPC-SP 13, Surface Preparation of Concrete.

3.07 COATING APPLICATION:

A. General

Coat all surfaces listed in the following "Coating Schedule".

B. Drying

1. Allow sufficient drying time between coats.
2. Modify the period as recommended by the material manufacturer to suit adverse weather conditions.
3. Oil-base and oleo-resinous solvent-type paints shall be considered dry for recoating when the paint feels firm, does not deform or feel sticky under moderate pressure of the thumb, and application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.

C. Environmental Conditions

1. Comply with the manufacturer's recommendations as to environmental conditions under which the coating systems may be applied.
2. Do not apply paint in areas where dust is being generated.
3. In absence of manufacturer's recommendations, the Contractor shall not apply exterior paint in damp, rainy weather, or when the ambient temperature is below 50°F. and interior paint when below 60°F.

D. Defects

Sand and dust between coats to remove all defects visible to the unaided eye from a distance of five feet.

E. Color of Undercoats

Slightly vary the color of succeeding coats.

3.08 DRY MIL THICKNESS:

Apply all coatings to the dry mil thickness indicated on manufacturer's Product Data Sheets.

3.09 REINSTALLATION OF REMOVED ITEMS:

Following completion of painting in each space, promptly reinstall all items removed for painting, using only workmen skilled in that particular trade.

3.10 CLEANING UP:

A. General

1. During progress of the work, do not allow the accumulation of empty containers or other excess items except in areas specifically set aside for that purpose.
2. Prevent accidental spilling of paint materials and, in the event of such a spill, immediately remove all spilled material and the waste or other equipment used to clean up the spill, and wash the surfaces to their original undamaged condition, all at no additional cost to the Owner.

B. Prior to Final Inspection

Upon completion of this portion of the work, visually inspect all surfaces and remove all paint and traces from surfaces not scheduled to be painted.

3.11 COATING SCHEDULE:

A. Interior and Exterior Wood:

1. Prime Coat (int): S-W Premium Int Wall & Wood Primer, B28W081111(1.4 mils dft)
Prime Coat (ext): S-W Exterior Latex Wood Primer, B42W08041(1.4 mils dft)
2. First Coat: S-W Pro Industrial Acrylic, B66 Series (3 mils dft)
3. Second Coat: Same as first coat.

B. Concrete Unit Masonry:

1. Exterior

- a. First Coat: Benjamin Moore's Silicone Acrylic Concrete (300 s.f. per gallon), Clear masonry waterproofing stain , S-W H&C Concrete Stain 111.08 (100-150 s.f. per gallon)
- b. Second Coat: Same as first coat

2. Interior

- a. Prime Coat: Benjamin Moorcraft interior and Exterior, S-W Loxon Concrete & Masonry Primer A24W8300 (3 mils dft)
- b. Block Filler: S-W P&M Heavy Duty Block Filler B42W46 (10/18 mils dft)
- c. First Coat: Moore's Alkyd Dulamel semi-gloss, S-W ProMar 200 Zero VOC Semi-Gloss, B31-2600 Series (1.6 mils dft)

- d. Second Coat: Same as first coat.

C. Metal Doors, Frames and Window Frames:

1. Touch-up: Cold Galvanize Spray Paint at all welds back side of frames
2. Prime Coat: Shop Prime
3. Field Prime: S-W Pro Industrial Pro-Cryl Acrylic Primer B66-310 (3 mils dft)
4. Top Coat: S-W Pro Industrial Acrylic, B66 Series (3 mils dft)

D. Exposed Metal Structures, Piping, Fittings, Valves, and Appurtenances, Including Outdoor Electrical Panels and Enclosures:

1. Prime: Tnemec Omnithane Series 1 3 mils dry
S-W Corothane I Mio-Zinc 3.0-4.0 mils dft
2. Intermediate: Tnemec N69 Hi-Build Epoxoline 4 mils dry
S-W Dura-Plate 235 4.0-8.0 mils dft
3. Top Coat: Tnemec Series 73 Endura Shield 2.5 mils dry
S-W Acrolon 218 HS 3.0-6.0 mils dft

E. Exposed PVC Piping, Fittings, and Appurtenances:

1. Prime:	Tnemec N69 Hi-Build Epoxoline S-W Macropoxy 646 FC	2.5 mils dry 2.0-3.0 mils dft
2. Top Coat:	Tnemec Series 73 Endura Shield S-W Acrolon 218 HS	2.5 mils dry 3.0-6.0 mils dft

4.00 MEASUREMENT AND PAYMENT

4.01 GENERAL:

See Section 01 22 00 – Measurement and Payment for General Requirements. See Section 01 01 00 – Special Requirements/Bid Items for possible modifications to Standard Bid Items. If no specific bid item is provided, measurement and payment shall be considered incidental and shall be included in the bid price for other items of work for the project.

4.02 MEASUREMENT AND PAYMENT:

A. Special provisions, requirements, revisions to these Bid Items, and/or additional Bid Items, may be included in Section 01 01 00 (green pages) or on the Drawings or Details.

B. Painting and Coating

1. Included shall be surface preparation, furnishing and installing all materials in conformance with these Specifications.
2. Payment shall be on a Lump Sum (L.S.) basis.

****END OF SECTION****

1.00 GENERAL

1.01 DESCRIPTION OF WORK:

- A. Work covered by this section includes all labor, materials, and equipment required for surface preparation and application of protective coatings as specified elsewhere in the Technical Specifications and as specified herein for treatment process equipment and facilities, and structures not included in Section 09 90 00, Architectural Paints and Coatings. If there is a conflict with other specification sections, the most stringent shall apply based as determined and approved by the Engineer.

- B. It is the intent that all new interior and exterior metal and submerged metal surfaces be painted, whether specifically mentioned or not.

- C. Unless specifically indicated in the Technical Specifications, the following items shall not be painted:
 - 1. Nonferrous and corrosion-resistant alloys such as copper, bronze, monel, aluminum, chromium plate, stainless steel, except where:
 - a. Required for electrical insulation between dissimilar metals.
 - b. Aluminum and stainless steel that is embedded in concrete or masonry, or aluminum in contact with concrete or masonry.
 - c. Color coding of equipment or piping system is required.
 - 2. Nonmetallic materials such as glass, PVC, wood, porcelain, and plastic except as required for architectural painting or color coding.
 - 3. Prefinished electrical and architectural items such as motor control centers, switchboards, switchgear, panelboards, transformers, disconnect switches, acoustical tile, cabinets, elevators, louvers, wall panels, except where color coding of equipment is required.
 - 4. Nonsubmerged electrical conduits attached to unpainted concrete surfaces.
 - 5. Cathodic protection anodes.
 - 6. Insulated piping or insulated piping with jacket, except as required for architectural painting or color coding.
 - 7. Moving parts of operating units such as valve and damper operators, linkages, sensing devices, motor and fan shafts, unless otherwise specified.
 - 8. Code required labels, such as Underwriters Laboratories, or any equipment data plates.

1.02 RELATED WORK:

- A. Section 01 33 00 - Submittal Procedures
- B. Section 09 90 00 - Architectural Painting and Coatings
- C. Divisions requiring surface preparation and application of high performance coatings include, but are not limited to, the following:
 - 1. Division 3 - Concrete
 - 2. Division 5 - Metals
 - 3. Division 21 - Fire Suppression
 - 4. Division 22 - Plumbing
 - 5. Division 23 - HVAC
 - 6. Division 40 - Process Integration
 - 7. Division 41 - Material Processing and Handling Equipment (Cranes and Hoists)
 - 8. Division 43 - Process Gas and Liquid Handling Storage and Equipment
 - 9. Division 46 - Water and Wastewater Equipment

1.03 REFERENCE STANDARDS:

- A. ASTM International:
 - 1. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications.
 - 2. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials.
 - 3. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- B. SSPC: The Society for Protective Coatings:
 - 1. SSPC - Painting Manual, Volume 2: Systems and Specifications.
 - 2. SSPC-Paint 16 - Coal Tar Epoxy-Polyamide Black (or Dark Red).
 - 3. SSPC-SP 2 - Hand Tool Cleaning.
 - 4. SSPC-SP 3 - Power Tool Cleaning.
 - 5. SSPC-SP 5 - White Metal Blast Cleaning.
 - 6. SSPC-SP 6 - Commercial Blast Cleaning.

7. SSPC-SP 7 - Brush-Off Blast Cleaning.
8. SSPC-SP 10 - Near-White Metal Blast Cleaning.
9. SSPC-SP 11 - Power Tool Cleaning to Bare Metal.
10. SSPC-SP 12, Surface Preparation and Cleaning of Metals Waterjetting Prior to Recoating.
11. SSPC-SP13/NACE No. 6 - Surface Preparation of Concrete

1.04 SUBMITTALS:

- A. Submittals shall be provided in accordance with Section 01 33 00 - Submittal Procedures.
- B. Finish Schedule: Submit finish schedule including color information, gloss and model number for each type and color of finish specified noting the location (rooms, item, etc.) that the paint or coating will be applied.
- C. Technical Data Sheets: For each paint system used herein, submit a technical data sheet from each paint manufacturer and paint colors available for each product used in the paint system. The technical data sheet shall at minimum provide the paint material name, manufacturer name, product name and number, material specification, minimum coats of coverage and thickness.
- D. Samples: Submit 8" x 10" drawdown samples for each finish product specified.
 1. Two samples minimum.
 2. Representing actual product, color, and sheen.
 3. Label with project and product specific information.
- E. Manufacture's Certification: Contractor shall submit certification that states that the factory applied coating system meets or exceeds the requirements specified herein.
- F. System Application Process (for each coating system): Surface preparation, primer, intermediate coat, finish coat for each paint system.
- G. Maintenance Instructions: Contractor shall submit Manufacturer's instructions for procedures and products required for re-coating of finish coat.
- H. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections. The Contractor shall use Paint Inspection Form approved by the Engineer.

1.05 DELIVERY AND STORAGE:

- A. Deliver all materials to the job site in original, new, and unopened packages and containers bearing manufacturer's name and label.
- B. Container Labeling: Provide labels on each container with the following information:

1. Name or title of material.
2. Federal Specification number, if applicable.
3. Manufacturer's stock number.
4. Manufacturer's name.
5. Contents by volume, for major pigment constituents.
6. Surface preparation instructions.
7. Thinning instructions.
8. Application instructions.
9. Drying time.
10. Cleanup requirements.
11. Color designation.

C. Storage:

1. Store materials in ventilated area and otherwise according to manufacturer instructions.
2. Store materials not in actual use in tightly covered containers.
3. Maintain containers used in storage, mixing, and application of paint in a clean condition, free of foreign materials and residue.

1.06 AMBIENT CONDITIONS:

- A. Section 01 50 00 - Temporary Facilities and Controls: Requirements for ambient condition control facilities for product storage and installation.
- B. Minimum Conditions: Do not install materials when temperature is below 55 degrees F (13 degrees C) or above 90 degrees F (32 degrees C).
- C. Subsequent Conditions: Maintain above temperature range, 24 hours before, during, and 72 hours after installation of coating.
- D. Provide adequate lighting level at substrate surface.
- E. Restrict traffic from area where coating is being applied or is curing.
- F. Do not apply paint when conditions are such that dust, dirt, or other deleterious substances which may impair the quality of coats or the finish are present or will be present before the coating is fully dry.

G. Comply with manufacturer's recommended limitations for ambient and surface temperature and humidity. No painting is to be done when the relative humidity exceeds 85 percent.

H. Comply with manufacturer's recommendations for minimum and maximum times between applications.

1.07 **WARRANTY:**

A. The Contractor shall provide a Manufacturer's guarantee to warrant the materials to be free of defects for a period of two (2) years from the Date of Substantial Completion and in accordance with the General Conditions.

B. The installation Contractor shall warrant the materials and workmanship to be free of defects in workmanship for a period of two (2) years from the Date of Substantial Completion and in accordance with the General Conditions.

2.00 PRODUCTS

2.01 **PAINT AND COATING SUPPLIERS:**

A. Specifications for non-latex, and non-urethane paint are based on products of the Tnemec Coatings, Inc., Kansas City, Missouri. Alternate products are discouraged and require Engineer's approval.

B. Paint finish coats shall be by the same Manufacturer of the prime coat and shall be compatible. Contractor shall be responsible for verifying compatibility with shop coating system used by manufacturers of Owner furnished equipment.

2.02 **COLOR REQUIREMENTS:**

A. All equipment shall be painted with the color as approved by the Engineer. All non-submerged portions of equipment shall be painted the same color as the process piping it serves, except as follows: dangerous parts of equipment and machinery shall be OSHA Orange, fire protection equipment and apparatus shall be OSHA Red, and physical hazards in normal operating areas shall be OSHA Yellow.

B. A process piping color schedule is provided in Table 09 96 00-1. Not all piping systems will be used on this project. Contractor is to request final process piping color schedule from the Engineer, as reviewed by the Owner, prior to furnishing paint system submittal.

C. Each coat of paint shall be darker than the preceding coat such that the finish coat is the darkest coat.

D. Colors shall be selected from "deep" pigments.

E. Colors shall be formulated with colorants free of lead and lead compounds.

F. Fiberglass reinforced plastic (FRP) equipment with an integral colored gel coat shall not require painting, provided the color is approved by the Engineer.

Table 09 96 00-1. Process Piping Color Schedule			
System Code	Piping System Description	Color	Tnemec Color ID
AAI/AAE	Anaerobic Basin Influent/Effluent	Dark Grey	34GR
ABI/ABE	Aeration Basin Influent/Effluent	Tan	
AOI/AOE	Anoxic Basin Influent/Effluent	Tan	
BW	Discfilter backwash	Aqua/Light Blue	10GN
CA/CAH	Chemical, Acid	Yellow with Red Band	02SF
CAS	Chemical, Aluminum Sulfate (alum)	Orange	04SF
CH	Chemical, Hypochlorite	Yellow	02SF
CP/PS	Chemical, Polymer	Orange with Green Band	04SF
CSH	Chemical, Sodium Hydroxide	Yellow with Green Band	02SF
CSB	Chemical, Sodium Bisulfate	Yellow with Red Band	02SF
CIP	Chemical, Clean-In-Place	Yellow	02SF
CI/CE	Clarifier Influent/Effluent	Tan	
DG/PD	Drain, Gravity or Plant Drain	Dark Grey	34GR
DP/PD	Drain, Pressure or Plant Drain	Dark Grey	34GR
FI/FE	Final Treatment Influent/Effluent	Aqua/Light Blue	10GN
GR	Grit Removal System	Dark Brown	84BR
HI/HE	Headworks Effluent	Dark Grey	34GR
IR/MLSS	Internal Recycle Activated Sludge	Tan	
FI	Filter Feed	Aqua/Light Blue	10GN
FE	Filter Filtrate	Aqua/Light Blue	10GN
FR	Discfilter Reject	Tan	
NG	Natural Gas	Yellow	02SF
RAS	Return Activated Sludge	Light Brown	34BR
RS	Raw Sewage/Septage	Dark Grey	34GR
SC	Scum/Skimmings	Dark Brown	84BR
WAS	Waste Activated Sludge	Dark Brown	84BR
WI	Water, Irrigation	Aqua/Light Blue	10GN
WU	Water, Utility	Aqua/Light Blue	10GN
WP1/2	Water, City and Plant Potable	True Blue/Safety	11SF
WR	Water, Reclaimed	Violet [Pantone 512]	
UVI	UV Disinfection System Influent	Aqua/Light Blue	10GN
UVE	UV Disinfection System Effluent	Aqua/Light Blue	10GN
	Hoists/Trolleys	Yellow	02SF
-	Fire Protection	Red	06SF

3.00 EXECUTION

3.01 GENERAL:

- A. Starting of painting work will be construed as the installer's acceptance of the surfaces and conditions within any particular area.
- B. Prefinished items: Unless otherwise indicated, do not include painting when factory finishing or installer finishing is specified. For factory finished items that require additional field painting see painting schedule Table 09 96 00-3. Paint Application Schedule.
- C. Remove all hardware, hardware accessories, machine surfaces, plates, lighting fixtures, and similar items in place and not to be finish-painted, or provide surface-applied protection prior to surface preparation and coating operations. Remove, if necessary, for the complete painting of the items and adjacent surfaces. Following completion of painting of each space or area, reinstall the removed items by workmen skilled in the trades involved.

3.02 INSPECTION:

- A. All work performed under this section shall be carefully inspected by the Contractor and Engineer for rejections or flaws to be corrected, and for proper compliance with plans and specifications.
- B. Owner furnished equipment shall be inspected by Contractor for compliance with this specification. If surface damage to paint system occurs prior to delivery, and if the Engineer determines that the damage cannot be repaired at the job site, the equipment will be returned to the factory for repair and returned to the job site at no cost to the Owner.
- C. Visual Inspection: The paint system will be visually inspected by the Engineer and/or Contractor. Show-through of substrate or previous coating will be grounds for rejection.

3.03 SURFACE PREPARATION:

- A. General: Perform preparation and cleaning procedures in strict accordance with the paint manufacturer's instructions and as herein specified, for each particular substrate condition.
- B. Installer must examine the areas and conditions under which painting work is to be applied. Notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected. Test previously painted or primed surfaces for compatibility with painting systems.
- C. Masking: Remove, mask, or otherwise protect surfaces or hardware not specified or intended to be painted or blasted, or surfaces which have received the finish coat.
- D. Clean surfaces to be painted before applying coating or surface treatments. Remove oil and grease prior to mechanical cleaning. Program the cleaning and painting so that contaminants from the cleaning process will not fall onto wet, newly coated surfaces.
- E. Metal Surface Preparation: All workmanship for metal surface preparation shall be in conformance with the current Steel Structures Painting Council (SSPC). All oil, grease, welding

fluxes, and other surface contaminants shall be removed prior to blast cleaning. All surfaces shall be cleaned of all dust and residual particles of the blast cleaning operations prior to painting. Surfaces that have started to rust before they are painted shall be re-blasted.

- F. Plastic Surface Preparation: All plastic surfaces to be coated shall be hand sanded to provide tooth for the coating system. Larger areas may be power sanded or brush-off blasted, provided sufficient controls are employed so that the surface is roughened without removing excess material. Wash sanded surfaces with detergent and rinse.
- G. Concrete and Masonry Preparation:
 - 1. Prepare surfaces of concrete and masonry to be painted by removing all efflorescence, chalk, dust, dirt, grease, oils, through etching, wire brushing, fiber brushing, stoning or scraping to remove glaze.
 - 2. Determine the alkalinity and moisture content of the surfaces to be painted by performing appropriate tests. Do not paint over surfaces where the alkalinity or moisture content exceeds that permitted in the manufacturer's printed directions.
- H. Previously primed or painted surfaces. Sand lightly to remove gloss. Wash with detergent and rinse.
- I. Protection from sandblasting: Thoroughly mask and protect from dust all mechanical and electrical equipment in vicinity of sandblasting. Repair all painted surfaces and equipment damaged by sandblasting.
- J. Non-ferrous metals shall not be painted.

3.04 APPLICATION:

- A. General:
 - 1. Apply paint in accordance with the manufacturer's directions. Use applicators and techniques best suited for the type of material being applied. Do not exceed manufacturer's recommended coverage per gallon.
 - 2. Apply additional coats when undercoats, stains, or other conditions show through the finish coating, until the paint film is of uniform finish color and appearance.
 - 3. Apply paint to surfaces behind movable equipment and furniture the same as similar exposed surfaces. Coat surfaces behind permanently-fixed equipment or furniture with prime coat and base coat only.
- B. Back priming: Ungalvanized structural steel, miscellaneous steel and iron work shall be back-primed prior to erection. Galvanized steel surfaces need not be back primed or painted. All ungalvanized metal brackets, angles, mechanical equipment mounting plates and miscellaneous devices mounted against concrete or masonry surfaces shall be back primed before installing.
- C. Factory finished items (including factory primer):

1. The Contractor shall repair or have repaired all surface damage to factory finished items. The Engineer shall determine if damage can be repaired at job site or if item is to be returned to the factory. Any coating done shall be equal to the original coating in every way and compatible with the shop coats.
 2. Where additional coats of paint are required, the factory applied primer shall be from the paint system selected, or be compatible with it. This finish coat will be field applied. Coordinate this work with equipment manufacturers. Colors will be selected by the Engineer.
- D. All pipe testing shall be done prior to any finish painting. Leak tests and all functional tests shall be completed prior to painting unless permitted otherwise by the Engineer.
- E. Coating inspection: Each coat of material shall be inspected and approved by the Engineer before applying succeeding coats; otherwise no credit for coat applied will be given, and Contractor assumes recoat responsibilities.
- 3.05 TESTING:
- A. Testing: Contractor is required to measure the Dry Film Thickness (DFT) in mils on all coated and galvanized ferrous surfaces with a calibrated magnetic non-destructive testing apparatus in the presence of the Resident Project Representative (RPR). The results of the testing shall be tabulated by the Contractor and submitted to the Engineer for approval.
- B. Minimum Number of Testing Locations: At minimum, each floor and wall surface shall be tested at 10-foot horizontal and vertical increments.
- C. Form 09 91 00-1 (Paint Inspection Form) to record the results of quality control inspections and tests. The completed reports shall be turned in to the Engineer before work resumes the following day. The form shall record the quality of surface preparation and measurements of surface profile, temperature, humidity, dew point and dry film thickness. One or more photos of the surface preparation shall be taken with a time stamp indicating the date and time taken. Reports and photos shall be uploaded on the project FTP site.
- D. Coverage rates for concrete and masonry surfaces will be determined by a count of empty containers. Remove or permanently deface labels of empty containers after counting by the Engineer. Remove empty, counted containers from the job site.
- 3.06 CLEANUP:
- A. Cleanup: During the progress of the work, remove from the project daily all discarded coating materials, rubbish, cans and rags.
- B. Cleaning: Upon completion of painting work, clean all window glass and other spattered surfaces. Clean by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.
- C. Corrected work: Correct any damages by cleaning, repairing, or replacing and painting as directed by the Engineer. Provide "Wet Paint" signs as required to protect newly-coated finishes.

Remove temporary protection wrappings provided by others for protection of their work, after completion of painting operations.

- D. Repair of defective work: Where any painted surface exhibits rust through its finished coat, all layers of primer and paint shall be removed down to the bare metal. The metal surface shall be prepared again to receive a completely new paint system. The new system shall be the same as the one removed or as selected by the Engineer.

3.07 PAINT SYSTEM SCHEDULE:

- A. Paint System Key. Substrate, Exposure, and Product Type are used to indicate the "Paint System" listed in table 09 96 00-2, paint system schedule. The Location is listed in table 09 96 00-3, paint application schedule.

- 1. Substrate (identify paint system, table 09 96 00-2)

Code Material

B	Cement Board
C	Concrete
D	Drywall or Plaster
F	Factory finish
G	Galvanized and Non-Ferrous Metal (only when directed)
M	Concrete Masonry Units (CMU)
P	Plastic (PVC, fiberglass)
S	Steel and Ferrous Metal
W	Wood (Plywood, particle board)

- 2. Exposure (identify paint system, table 09960-2)

Code Environment

I-NC	Interior/non-corrosive
I-C	Interior/corrosive
E-NC	Exterior/non-corrosive
E-C	Exterior/corrosive
B	Buried
S	Immersed or Submerged
W	Wet, high humidity

Interior: Within enclosed space, not exposed to elements; not buried, exterior, or submerged. (Note: Exterior paint systems are, in places, scheduled for interior use.)

Exterior: Not within enclosed space, exposed to elements; not buried or submerged. (Note: Exterior paint systems are, in places, scheduled for interior use.)

Submerged: In contact with water or sewage. Paint system shall extend to 1 foot above high water line unless indicated otherwise.

Corrosive: Areas above or near wastewater holding basins/wet wells.

Buried: Areas below grade.

3. Coating Type (identify paint system, table 09960-2)

Code Coating Type

A	Alkyd enamel
B	Bituminous (also coal tar epoxy)
BZ	Bituminous and Zinc Epoxy
C	Powder Coating (electrostatic)
E	Epoxy (non-bituminous)
L	Semi-gloss (acrylic-latex)
H	Hardener (concrete, see section 03370)
N	No finish
O	Oil based stain & varnish
P	Plastic (acrylic gloss enamel)
PR	Primer
T	Textured high-build
U	Urethane stain or varnish
V	Vinyl

4. Location (indicated in application schedule, table 09960-3)

E	Exterior of Equipment, Tank, Structure, or Pipe
S	Submerged exterior of equipment extending to 1-foot above high water line.
NS	Non-submerged exterior of equipment 1-foot above water line and higher.
I	Interior of Equipment, Tank, or Structure

B. Paint System Schedule

HIGH PERFORMANCE COATINGS

Table 09 96 00-2. Paint System Schedule		
Surface Preparation	Paint Materials	Minimum Coats, Cover
System No. S-I-C-E: Steel, Interior, Corrosive, Epoxy		
Commercial Blast Clean (SP-6) after assembly	MCU Primer, open recoat window (Tnemec Series 1 Omnithane Primer)	2.5 - 3.5 mils DFT
	Epoxy Polyamidoamine Primer (Tnemec Series N69 Hi-Build Epoxoline II)	3.0 - 5.0 mils DFT
	Epoxy Polyamidoamine Primer (Tnemec Series N69 Hi-Build Epoxoline II)	4.0 - 6.0 mils DFT
System No. S-E-C-E: Steel, Exterior, Corrosive, Epoxy		
Commercial Blast Clean (SP-6) after assembly	MCU Primer, open recoat window (Tnemec Series 1 Omnithane Primer)	2.5 - 3.5 mils DFT
	Epoxy Polyamidoamine Primer (Tnemec Series N69 Hi-Build Epoxoline II)	3.0 - 5.0 mils DFT
	Epoxy Polyamidoamine Primer (Tnemec Series N69 Hi-Build Epoxoline II)	3.0 - 5.0 mils DFT
	Polyurethane Finish (Tnemec Series 73 Endura-Shield)	3.0 - 5.0 mils DFT
System No. S-S-BU: Steel, Submerged, MCU Primer, open recoat window, MCU Urethane Finish		
Abrasive Blast (SP-10)	MCU Primer, open recoat window (Tnemec Series 1 Omnithane Primer)	2.5 - 3.5 mils DFT
	MCU Urethane (Tnemec Series 446 PermaShield MCU) MCU Urethane (Tnemec Series 446 PermaShield MCU)	7.0 - 10.0 mils DFT 7.0 - 10.0 mils DFT
Paint System S-I-C-E-CAS Steel Interior Corrosive Environment (Chemical Exposure to Sodium Hydroxide and Aluminum Sulfate)		
Abrasive Blast (SP-13)	MCU Primer, open recoat window (Tnemec Series 1 Omnithane Primer)	2.5 - 3.5 mils DFT
	Finish: Modified Polyamine Epoxy (Tnemec Series 22 Epoxoline)	16.0 – 20.0 mils DFT
Paint System C-E-C-E-SC Concrete Exterior Corrosive Environment (Secondary Containment Area)		
28 days cure time for concrete, or until passing ASTM D 4263 Plastic Mat test.	Surfacer Filler Epoxy Mortar (Tnemec Series 218 MortarClad)	1/16" minimum, fill all bug holes and surface voids flush to plane.
	100% Solids Modified Polyamine Epoxy (Tnemec Series 280 Tneme-Glaze)	8.0 to 10.0 mils DFT
Abrasive Blast (SP-13)	Non-Skid Floor: Broadcast 50-60 mesh aggregate (e.g. dry wash silica sand into wet prime coat.) Remove excess aggregate after cured.	
	100% Solids Modified Polyamine Epoxy	8.0 to 10.0 mils DFT

Table 09 96 00-2. Paint System Schedule		
Surface Preparation	Paint Materials	Minimum Coats, Cover
	(Tnemec Series 280 Tneme-Glaze)	
Paint System C-I-C-E-CAS Concrete Interior Corrosive Environment (Chemical Exposure to Sodium Hydroxide and Aluminum Sulfate)		
Abrasive Blast (SP-13)	Surfacer Filler Epoxy Mortar (Tnemec Series 218 MortarClad)	1/32" minimum, fill all bug holes and surface voids flush to plane.
	Finish: Modified Polyamine Epoxy (Tnemec Series 22 Epoxoline)	16.0 – 20.0 mils DFT
Paint System C-I-C-E-H2S Concrete Interior Corrosive Environment Glaze		
Abrasive Blast (SP-13)	Surfacer Filler Epoxy Mortar (Tnemec Series 218 MortarClad)	1/16" minimum, fill all bug holes and surface voids flush to plane.
	Primer: 100% Modified Polyamine Epoxy (Tnemec Series 435 PermaGlaze)	20.0 to 25.0 mils DFT
	Finish: 100% Modified Polyamine Epoxy (Tnemec Series 435 PermaGlaze)	20.0 to 25.0 mils DFT

3.06 PAINT APPLICATION SCHEDULE

Table 09 96 00-3. Paint Application Schedule			
Equipment Spec. No.	Equipment Name	Paint System(s)	Location on Item
03 30 00	Precast Concrete Structure – Filter feed lift station	C-E-C-E-H2S	I
05 50 00	Metal Fabrications, Exterior	S-E-C-E	E
05 50 00	Metal Fabrications, Interior	S-I-C-E	E
05 50 00	Metal Fabrications, Submerged	S-S-BU	S
05 50 00	Metal Fabrications, Chemical Exposure	S-I-C-E-CAS	E
40 05 07	Hangers and Supports for Process Piping, Exterior	S-E-C-E	E
40 05 07	Hangers and Supports for Process Piping, Interior	S-I-C-E	E
40 05 07	Hangers and Supports for Process Piping, Submerged	S-S-BU	S
40 05 07	Hangers and Supports for Piping, Chemical Exposure	S-I-C-E-CAS	E
Division 21, 22, 23, 40	Exposed Piping, Exterior (Ductile Iron, Cast Iron, Galvanized Steel, and Black Iron)	S-E-C-E	E
Division 21, 22, 23, 40	Exposed Piping, Interior (Ductile Iron, Cast Iron, Galvanized Steel, and Black Iron)	S-I-C-E	E
40 04 19	Exposed Piping, Submerged (Ductile Iron, Cast Iron, Galvanized Steel, and Black Iron)	S-S-BU	E
40 04 19	Exposed Piping, Chemical Exposure (Ductile Iron, Cast Iron, Galvanized Steel, and Black Iron)	S-I-C-E-CAS	E
40 05 51	Process Valves, Exterior	S-E-C-E	E
40 05 51	Process Valves, Interior	S-I-C-E	E
40 05 51	Process Valves, Submerged	S-S-BU	S
40 05 51	Process Valves, Chemical Exposure	S-I-C-E-CAS	E
40 05 59	Gate Operators, Exterior	S-E-C-E	E (1)
40 05 59	Gate Operators, Interior	S-I-C-E	E (1)
41 22 13	Cranes and Hoists, Interior	S-I-C-E	E (1)
43 23 13	Self-Priming Centrifugal Liquid Pumps	S-I-C-E	E (1)
43 23 31	Vertical In-line Centrifugal Pumps	S-I-C-E	E (1)
43 25 00	Submersible Sewage Pumps	S-S-BU	S (2)
46 41 11	Flash Mixers – Drive Assembly	S-I-C-E	E (1)
46 41 34	Flocculators – Drive Assembly	S-I-C-E	E (1)
46 61 33	Discfilter Filtration System a. Backwash Pumps b. Tanks (except stainless steel) c. Ductile or cast iron valves d. Non-stainless steel or non-plastic components.	S-I-C-E	E (1)
46 61 73	Automatic Strainers	S-I-C-E	E (1)

- (1) Manufacturer to provide prime coat.**
- (2) Manufacturer to provided prime coat and finish coat. Contractor to perform touch-up as required according to this specification section.**

***** END OF SECTION *****

1.00 GENERAL

1.01 DESCRIPTION:

- A. This work included in this Section consists of furnishing and installing indoor and outdoor signs as shown on the Drawings.
- B. Special provisions, requirements and/or revisions to this Specification and/or Bid Item(s) may be included in Section 01 01 00 (green pages) and/or on the Drawings or Details.

1.02 SUBMITTALS:

Submittals shall conform to Section 01 33 00 of the Specifications. Submit sign layout, materials of construction, color and wording prior to manufacture of the signs.

2.00 PRODUCTS

2.01 INDOOR SIGNS:

Indoor signs shall be constructed of acrylic material with a minimum thickness of 1/8-inch. Signs shall have rounded corners and be UV resistant. Mounting holes shall be pre-drilled.

2.02 OUTDOOR SIGNS:

Outdoor signs shall be constructed of sheet aluminum having a minimum thickness of 0.063 inches. Corners shall be rounded. Sign background and lettering shall be “Scotchcal”, UV and weather resistant, suitable for outdoor use. Mounting holes shall be pre-punched.

3.00 EXECUTION

3.01 INSTALLATION:

- A. All signs shall be securely anchored at the locations to be determined by the Owner or shown on the Drawings or as approved by the Engineer.
- B. Signs shall be anchored with stainless steel hardware. Unless otherwise shown or noted on the Drawings, all outdoor signs shall be mounted on posts driven into the ground. Posts and any required framing shall be galvanized steel or treated wood and shall be sufficient for a rigid permanent installation.

4.00 MEASUREMENT AND PAYMENT

4.01 GENERAL:

- A. See Section 01 22 00 – Measurement and Payment for General Requirements. See Section 01 01 00 – Special Requirements/Bid Items for possible modifications to Standard Bid Items.
- B. If no specific bid item is provided, measurement and payment shall be considered incidental and shall be included in the bid price for other items of work for the project.

4.02 BID ITEMS:

- A. Special provisions, requirements, revisions to these Bid Items, and/or additional Bid Items, may be included in Section 01 01 00 (green pages) or on the Drawings or Details.
- B. Signs
 - 1. Included shall be furnishing and installing all materials in conformance with these Specifications.
 - 2. Payment shall be on a lump sum (L.S.) basis.

****END OF SECTION****

1.00 GENERAL

1.01 DESCRIPTION OF WORK:

- A. Work consists of providing all labor, materials and equipment for the installation of all signage shown on drawings and specified herein.
- B. Work included:
 - 1. Room signs factory finished.
 - 2. Adhesive and hardware for attachment.
- C. Special provisions, requirements and/or revisions to this Specification and/or Bid Item(s) may be included in Section 01 01 00 (green pages) and/or on the Drawings or Details.

1.02 SUBMITTALS:

- A. Samples
 - 1. Submit samples in accordance with Section 01 33 00.
 - 2. Provide sample of each specified sign type as requested by Engineer. Sample shall indicate materials and methods of construction but need not be a complete sign.
- B. Shop drawings
 - 1. Submit shop drawings in accordance with Section 01 33 00.
 - 2. Submit a representative layout drawing of each sign to be supplied. Layout drawing shall show lettering, numerals, arrows and symbols to scale.

1.03 DELIVERY:

- A. Package separately or in like groups of names, labeled as to names enclosed. Include installation template, hardware or adhesive specified and installation instructions.

2.00 PRODUCTS

2.01 SAFETY SIGNS AND MAINTENANCE TAGS:

- A. General
 - 1. Equipment installation is not complete until Contractor has provided and installed all required OSHA safety labeling signs and tags.
- B. Sign description
 - 1. All signs shall be of reinforced polyester with a minimum thickness of 0.100 (ASTM D 1593). Flammability shall be in conformance with ASTM D 635.
 - 2. Guarantee: guarantee not to chip, fade, shatter or peel for a period of 15 years.

- 3. Signs shall be rated for indoor and outdoor use.
- 4. Sign size: All signs 10 inch by 14 inch unless noted otherwise.

C. Safety sign and tag name schedule:

Amount bid shall include all OSHA required safety labeling signs and tags as well as all signs shown on the drawings. In addition, the following signs shall be furnished and installed. Locations which are not specified shall be owner determined.

<u>SIGN NAME</u>	<u>QUANTITY</u>
<u>Danger</u> Crane Overhead	2
<u>Non Potable Water</u> Do Not Drink	5
<u>No Trespassing</u> No Trespass	2
<u>Danger</u> Hazardous Chemicals	5
<u>Caution</u> Ear Protection Required Beyond This Point	2
<u>Caution</u> This Equipment Starts And Stops Automatically	2

<u>SIGN NAME</u>	<u>QUANTITY</u>
<u>Caution</u> This Space Must Be Kept Clear At All Times	1
<u>Think</u> Keep This Place Clean And Orderly	1

- D. Chain fall markers showing appropriate load capacity shall be required for each chain tackle or pull lift.
- E. Maintenance tags: Provide the following tags meeting OSHA construction standards.

<u>Tag Name</u>	<u>Quantity</u>
Do Not Operate	6
Out Of Order	6

3.00 EXECUTION

3.01 INSTALLATION:

- A. Install signs either by means of adhesive backing or with screws, but no screws will be permitted in hollow metal door surfaces.
- B. Follow manufacturer's mounting details and instructions.
- C. Install signs after mounting surfaces have been painted.
- D. Install centered and level in line with Engineer's recommendations.
- E. Clean, remove excess adhesive.

END OF SECTION

1.00 GENERAL

1.01 DESCRIPTION:

- A. The work included in this Section consists of designing, furnishing, and installing a cross connection control system to isolate the Wastewater Treatment Plant (WWTP) water from the City's potable water supply and to meet all applicable cross connection control requirements. System shall include duplex, two (2) pumps, packaged water pressure booster system, pressure tank, control valves, water storage, skid, and electrical/controls as required for a fully operational system. Controls shall allow remote monitoring by the WWTP SCADA system. The system shall be furnished complete with pumps, motors, valves, piping, fittings, wiring, controls, support bases, and all other items, equipment, appurtenances, etc. required for a fully operational cross connection control system. The pressure booster system shall be furnished as a complete factory assembled package requiring only field piping connections, and required electrical connections. The entire packaged pump system shall be certified and labeled by Underwriters Laboratory, under category QCZJ for packaged pump systems.
- B. System shall be an approved cross connection control system providing an air gap and repump system meeting requirements of WAC 246-290-490 and all applicable local, state, and federal cross connection control requirements for this installation. The manufacturer shall design the system for the cross connection control requirements and certify in writing the system meets the applicable requirements.
- C. All electrical and controls components shall be in conformance with Div. 26 of these contract documents.
- D. The terms cross connection control system and air gap system herein are identical terms and will be used interchangeably.
- E. Special provisions, requirements and/or revisions to this Specification and/or Bid Item(s) may be included in Section 01 01 00 (green pages) and/or on the Drawings or Details.

1.02 SUBMITTALS:

- A. Submittals shall conform to Section 01 33 00 of these Specifications, and shall include complete manufacturer's literature, drawings, installation instructions, operation and maintenance manuals and written warranties for all pieces of equipment and accessories. Submittals shall include the following information:
 - 1. Complete assembly drawings, together with data covering installation materials, drive unit, parts, devices, and accessories forming a part of the equipment furnished, shall be submitted for approval. Included in the submittal shall be pump manufacturer's materials of construction, specifications, performance curves and detailed dimensional information. Provide system valve submittal data including manufacturer's specifications, performance ratings and dimensions. Manufacturer's electrical requirements for the pump station shall include control wiring ladder diagrams, control panel construction details and component cut sheets.
- B. Operation and maintenance manuals shall be supplied and shall include the following:

1. Manufacturers data as outlined in the submittal portion of this specification. Equipment function, normal operating characteristics, and limiting conditions. Include all assembly, installation, alignment, adjustment, and checking and maintenance instructions. The operation and maintenance manuals shall be in addition to any instructions or parts lists packed with or attached to the equipment items when delivered.

1.03 ACCEPTABLE MANUFACTURER / QUALITY ASSURANCE:

- A. Pump Tech, or approved equal. Approval of an alternate shall follow process outlined in Article 11 of the Instructions to Bidders.
- B. For the actual installation of the cross connection control system, the Contractor shall utilize only skilled personal who are thoroughly experienced with the equipment and methods required for the installation.

1.04 WARRANTY:

- A. The cross connection control system manufacturer shall warrant all equipment to be of quality construction, free of defects in material and workmanship. A written warranty shall include specific details described below.
- B. The equipment, apparatus, and parts furnished shall be warranted for a period of five (5) years, excepting only those items that are normally consumed in service, such as light bulbs, oils, grease, packing, gaskets, O-rings, etc. The Contractor shall be responsible for the warranty of the pumping system and all components.
- C. Components failing to perform as specified by the engineer, or as represented by the manufacturer, or as prove defective in service during the warranty period, shall be replaced, repaired, or satisfactorily modified by the Contractor without cost or parts or labor to the owner.
- D. In order to unify responsibility for proper operation of the complete pumping system, it is the intent of these specifications that all system components be furnished by a single supplier (unitary source). The pumping station must be of standard catalog design, totally warranted by the manufacturer. Under no circumstances will a system consisting of parts compiled and assembled by a Contractor/Manufacturer's representative or distributed be accepted.

1.05 SPARE PARTS:

- A. The following spare parts shall be provided:
 1. Spare parts for all scheduled operation and maintenance tasks for the first 2 years shall be supplied with the system.
 2. Three (3) fuse sets of each size and type.
 3. Backup copy of all programmed control parameters.

1.06 REFERENCE STANDARDS:

- A. The work and equipment herein shall be meet the requirements of all applicable industry standards including:

1. Hydraulic Institute
2. ANSI – American National Standards Institute
3. ASTM – American Society for Testing and Materials
4. IEEE – Institute of Electrical and Electronics Engineers
5. NEMA – National Electrical Manufacturers Association
6. NEC – National Electrical Code
7. ISO – International Standards Organization
8. UL – Underwriters Laboratories, Inc.

1.07 CROSS CONNECTION CONTROL SYSTEM APPLICATIONS ENGINEERING:

- A. The cross connection control equipment shall be designed, selected and installed in accordance with the applications engineering recommendations of the manufacturer, who shall review the application, design and specifications included herein and on the plans, as well existing conditions and water use (see paragraph 2.01 A.) for conformance with such recommendations. If additional design or operating data is needed by the manufacturers for such review, it shall be the Bidder's responsibility to request same from the Engineer at least 5 working days prior to bid opening date.

2.00 PRODUCTS

2.01 SYSTEM OPERATIONAL AND SPACE REQUIREMENTS

- A. Contractor shall provide cross connection control system designer with all water demand requirements for the wastewater treatment plant including equipment, hose bibs, showers, spray nozzles, and sinks. System shall be sized and designed to provide water service (pressure and flow) as needed for full operation of the treatment plant including equipment demands and operation and maintenance tasks. System shall have a minimum capacity as specified herein.
- B. Contractor shall confirm sizing of waterline serving mechanical dewatering building in coordination with cross connection control system designer and centrifuge manufacturer.
- C. System shall be designed to fit within the building openings and space shown on the plans including ceiling height and shall have adequate room to allow for all maintenance tasks. System dimensions and size shall allow removal from through the access door provided. Some disassembly may be allowed if approved by the Owner.

2.02 PUMPS:

- A. All pumps shall be ANSI NSF 61 / NSF372 Listed for drinking water and low lead requirements.
- B. The pumps shall be of the in-line vertical multi-stage design.
- C. The head-capacity curve shall have a steady rise in head from maximum to minimum flow within the preferred operating region. The shut-off head shall be a minimum of 20% higher than the head at the best efficiency point.
- D. Pumps shall have the following features:
1. The pump impellers shall be secured directly to the pump shaft by means of a splined shaft arrangement.

- 2. The suction/discharge base shall have ANSI Class 250 flange or internal pipe thread (NPT) connections as determined by the pump station manufacturer.
- 3. Pump Construction.
 - a. Suction/discharge base, pump head, motor stool: Cast iron (Class 30)
 - b. Impellers, diffuser chambers, outer sleeve: 304 Stainless Steel
 - c. Shaft 316/431 Stainless Steel
 - d. Impeller wear rings: 304 Stainless Steel
 - e. Shaft journals and chamber bearings: Silicon Carbide
 - f. O-rings: EPDM

Shaft couplings for motor flange sizes 184TC and smaller shall be made of cast iron or sintered steel. Shaft couplings for motor flange sizes larger than 184TC shall be made of ductile iron (ASTM 60-40-18).

Optional materials for the suction/discharge base and pump head shall be cast 316 stainless steel (ASTM CF-8M) resulting in all wetted parts of stainless steel.

- 4. The shaft seal shall be a balanced o-ring cartridge type with the following features:
 - a. Collar, Drivers, Spring: 316 Stainless Steel
 - b. Shaft Sleeve, Gland Plate: 316 Stainless Steel
 - c. Stationary Ring: Silicon Carbide
 - d. Rotating Ring: Silicon Carbide
 - e. O-rings: EPDM

The Silicon Carbide shall be imbedded with graphite.

- 5. Shaft seal replacement shall be possible without removal of any pump components other than the coupling guard, shaft coupling and motor. The entire cartridge shaft seal shall be removable as a one piece component. Pumps with motors equal to or larger than 15 hp (fifteen horsepower) shall have adequate space within the motor stool so that shaft seal replacement is possible without motor removal.
- 6. Minimum pump performance characteristics are below:

	Design Flow (1)	Min Flow	Design Pressure (2)
Pump 1	100 GPM	0 GPM	75 PSI
Pump 2	100 GPM	0 GPM	75 PSI

(1) Each pump shall capable of delivering 100 gpm at a discharge pressure of 75 psi.

(2) System shall be capable of a discharge pressure of 75 psi for the full range of flows including both pumps operating at the design flow rate.

2.03 INTEGRATED VARIABLE FREQUENCY DRIVE MOTORS:

- A. Each motor shall be of the Integrated Variable Frequency Drive design consisting of a permanent magnet synchronous motor (ECM) and a Variable Frequency Drive (VFD) built and tested as one unit by the same manufacturer. Motor shall include factory installed shaft grounding rings.
 - B. The VFD shall be of the PWM (Pulse Width Modulation) design using IGBT (Insulated Gate Bipolar Transistor) technology.
 - C. The VFD shall convert incoming fixed frequency three-phase AC power into a variable frequency and voltage for controlling the speed of motor. The motor current shall closely approximate a sine wave. Motor voltage shall be varied with frequency to maintain desired motor current suitable for centrifugal pump control and to eliminate the need for motor de-rating.
 - D. The VFD shall automatically reduce the switching frequency and/or the output voltage and frequency to the motor during periods of sustained ambient temperatures that are higher than the normal operating range. The switching frequency shall be reduced before motor speed is reduced.
 - E. An integral RFI filter shall be standard in the VFD.
 - F. The VFD shall have a minimum of two skip frequency bands which can be field adjustable.
 - G. The VFD shall have internal solid-state overload protection designed to trip within the range of 105-110% of rated current.
 - H. The integrated VFD motor shall include protection against input transients, phase imbalance, loss of AC line phase, over-voltage, under-voltage, VFD over-temperature, and motor over-temperature. Three-phase integrated VFD motors shall be capable of providing full output voltage and frequency with a voltage imbalance of up to 10%.
 - I. The integrated VFD motor shall have, as a minimum, the following input/output capabilities:
 - 1. Speed Reference Signal: 0-10 VDC, 4-20mA
 - 2. Digital remote on/off
 - 3. Fault Signal Relay (NC or NO)
 - 4. Fieldbus communication port (RS485)
 - J. The motor shall be Totally Enclosed Fan Cooled (TEFC) with a standard NEMA C-Face, Class F insulation with a temperature rise no higher than Class B.
 - K. The cooling design of the motor and VFD shall be such that a Class B motor temperature rise is not exceeded at full rated load and speed at a minimum switching frequency of 9.0 kHz.
 - L. The overall efficiency of the VFD and motor must exceed NEMA Premium Efficiency.
 - M. Motor drive end bearings shall be adequately sized so that the minimum L10 bearing life is 20,000 hours at the minimum allowable continuous flow rate for the pump at full rated speed.
- 2.04 PUMP SYSTEM CONTROLLER:
- A. The pump system controller shall be a standard product developed and supported by the pump manufacturer.

- B. The controller shall be microprocessor based capable of having software changes and updates via personal computer (notebook). The controller user interface shall have a color display with a minimum screen size of 3-1/2" x 4-5/8" for easy viewing of system status parameters and for field programming. The display shall have a back light with contrast adjustment. Password protection of system settings shall be standard.
- C. The controller shall provide internal galvanic isolation to all digital and analog inputs as well as all fieldbus connections.
- D. The controller shall have the ability to be connected to a battery to maintain power on controller during periods of loss of supply power.
- E. The controller shall have built in data logging capability. Logged values shall be graphically displayed on the controller and able to be exported. A minimum of 3600 samples per logged value with the following parameters available for logging:
1. Estimated flow-rate
 2. Speed of pumps
 3. Inlet pressure
 4. Process Value (usually discharge pressure or differential pressure depending on application)
 5. Power consumption
 6. Controlling parameter (process value)
- F. The controller shall display the following as status readings from a single display on the controller (this display shall be the default):
1. Current value of the control parameter, (typically discharge pressure)
 2. Most recent existing alarm (if any)
 3. System status with current operating mode
 4. Status of each pump with current operating mode and rotational speed as a percentage (%)
 5. Estimated flow-rate, (not requiring flow meter connection)
- G. The controller shall have as a minimum the following hardware inputs and outputs:
1. Three analog inputs (4-20mA or 0-10VDC)
 2. Three digital inputs
 3. Two digital outputs
 4. Ethernet connection
 5. Field Service connection to PC for advanced programming and data logging
- H. Pump system programming (field adjustable) shall include as a minimum the following:
1. Water shortage protection (analog or digital)
 2. Sensor Settings (Suction, Discharge, Differential Pressure analog supply/range)
 3. PI Controller (Proportional gain and Integral time) settings
 4. High system pressure indication and shut-down
 5. Low system pressure indication and shut-down
 6. Low suction pressure/level shutdown (via digital contact)
 7. Low suction pressure/level warning (via analog signal)
 8. Low suction pressure/level shutdown (via analog signal)

9. Flow meter settings (if used, analog signal)
- I. The system controller shall be able to accept up to seven programmable set-points via a digital input, (additional input/output module may be required).
- J. The controller shall have advanced water shortage protection. When analog sensors (level or pressure) are used for water shortage protection, there shall be two indication levels. One level is for warning indication only (indication that the water level/pressure is getting lower than expected levels) and the other level is for complete system shut-down (water or level is so low that pump damage can occur). System restart after shut-down shall be manual or automatic (user selectable).
- K. The system pressure set-point shall be capable of being automatically adjusted by using an external set-point influence. The set-point influence function enables the user to adjust the control parameter (typically pressure) by measuring an additional parameter. (Example: Lower the system pressure set-point based on a flow measurement to compensate for lower friction losses at lower flow rates).
- L. The controller shall be capable of receiving a remote analog set-point (4-20mA or 0-10 VDC) as well as a remote system on/off (digital) signal.
- M. The controller shall be able to adjust the ramp time of a change in set point on both an increase or decrease change in set point.
- N. The pump system controller shall store up to 24 warning and alarms in memory. The time, date and duration of each alarm shall be recorded. A potential-free relay shall be provided for alarm notification to the building management system. The controller shall display the following alarm conditions:
- | | |
|--|---------------------------------|
| High System Pressure | Low system pressure |
| Low suction pressure (warning and alarm) | Individual pump failure |
| VFD trip/failure | Loss of sensor signal (4-20 mA) |
| Loss of remote set-point signal (4-20mA) | External Fault |
- O. The pump system controller shall be mounted in a UL Type 3R rated enclosure. A self-certified NEMA enclosure rating shall not be considered equal. The entire control panel shall be UL 508 listed as an assembly. The control panel shall include a main disconnect, circuit breakers for each pump and the control circuit and control relays for alarm functions.
- Control panel options shall include, but not be limited to:
- | | |
|---|-------------------------------------|
| Pump Run Lights | System Fault Light |
| Surge Arrestor | Emergency/Normal Operation Switches |
| Service Disconnect Switches | |
| Qty (9) Configurable Digital Outputs available for monitoring | |
| Qty (7) Configurable Digital Inputs available for control | |
- P. The controller shall be capable of receiving a redundant sensor input to function as a backup to the primary sensor (typically discharge pressure).
- Q. The controller shall have a pump “Test Run” feature such that pumps are switched on during periods of inactivity (system is switched to the “off” position but with electricity supply still

- connected). The inoperative pumps shall be switched on for a period of two to three (3-4) seconds every 24 hours, 48 hours or once per week and at specific time of day (user selectable).
- R. The controller shall be capable of changing the number of pumps available to operate or have the ability limit the maximum power consumption by activation of a digital input for purposes of limited generator supplied power.
- S. The controller shall be capable of displaying instantaneous power consumption (Watts or kilowatts) and cumulative energy consumption (kilowatt-hours).
- T. The controller shall be capable of displaying instantaneous specific energy use (kW/gpm), (optional flow meter must be connected).
- U. The actual pump performance curves (5th order polynomial) shall be loaded (software) into the pump system controller. Pump curve data shall be used for the following:
1. Display and data logging of calculated flow rate (not requiring flow measurement)
 2. Proportional pressure control
 3. Pump outside of duty range protection
 4. Pump cascade control based on pump efficiency
- V. The controller shall be capable of displaying an estimated flow-rate on the default status screen.
- W. The controller shall have proportional pressure control to compensate for pipe friction loss by decreasing pressure set-point at lower flow-rates and increasing pressure set-point at higher flow-rates by using actual flow rate or calculated flow rate. Proportional pressure control that uses pump speed or power consumption only shall not be considered equal to proportional pressure control that uses actual or calculated flow rate.
- X. The controller shall have the ability to communicate common field-bus protocols, (BACnet, Modbus, Profibus, and LON), via optional communication expansion card installed inside controller.
- Y. The controller shall have Ethernet connection with a built in server allowing for connection to a network with read/write access to controller via web browser and internet.
- Z. The controller shall have a programmable Service Contact Field that can be populated with service contact information including: contact name, address, phone number(s) and website.
- 2.05 BOOSTER SYSTEM SEQUENCE OF OPERATION:
- A. The system controller shall operate equal capacity variable speed pumps to maintain a constant discharge pressure or differential pressure (system set-point), depending on the application. The system controller shall receive an analog signal [4-20mA] from the factory installed pressure transducer on the discharge manifold, indicating the actual system pressure.

Standard Cascade Control (Pumping Efficiency Based):

The pump system controller shall adjust pump speed as necessary to maintain system set-point pressure as flow demand increases. Utilizing the pump curve information (5th order polynomial), the pump system controller shall stage on additional pumps when pump hydraulic efficiency will

be higher with additional pumps in operation. Exception: When the flow and head are outside the operating pump(s) allowable operating range the controller shall switch on an additional pump thus distributing flow and allowing all pump(s) to operate in allowable operating range. When the system pressure is equal to the system set-point, all pumps in operation shall reach equal operating speeds. The pump system controller shall have field adjustable Proportional Gain and Integral time (PI) settings for system optimization.

Optional Cascade Control (Pump Start Speed Based):

As flow demand increases the pump speed shall be increased to maintain the system set-point pressure. When the operating pump(s) reach 96% of full speed (adjustable), an additional pump will be started and will increase speed until the system set-point is achieved. When the system pressure is equal to the system set-point all pumps in operation shall reach equal operating speeds. The pump system controller shall have field adjustable Proportional Gain and Integral time (PI) settings for system optimization.

- B. The system controller shall be capable of switching pumps on and off to satisfy system demand without the use of flow switches, motor current monitors or temperature measuring devices.
- C. All pumps in the system shall alternate automatically based on demand, time and fault. If flow demand is continuous (no flow shut-down does not occur), the system controller shall have the capability to alternate the pumps every 24 hours, every 48 hours or once per week. The interval and actual time of the pump change-over shall be field adjustable.
- D. The system controller shall be able to control a pressure maintenance pump, (jockey pump), in the system in pressure boosting applications. The set point of the pressure maintenance pump shall be able to be any value above or below the pump system's set point. The pressure maintenance pump shall be able to be staged on as back-up pump when capacity of pump system is exceeded.

2.06 LOW FLOW STOP FUNCTION (Constant Pressure Applications):

The system controller shall be capable of stopping pumps during periods of low-flow or zero-flow without wasting water or adding unwanted heat to the liquid. Temperature based no flow shut-down methods that have the potential to waste water and add unwanted temperature rise to the pumping fluid are not acceptable and shall not be used.

Standard Low Flow Stop and Energy Saving Mode

If a low or no flow shut-down is required (periods of low or zero demand) a bladder type diaphragm tank shall be installed with a pre-charge pressure of 70% of system set-point. The tank shall be piped to the discharge manifold or system piping downstream of the pump system. When only one pump is in operation the system controller shall be capable of detecting low flow (less than 10% of pump nominal flow) without the use of additional flow sensing devices. When a low flow is detected, the system controller shall increase pump speed until the discharge pressure reaches the stop pressure (system set-point plus 50% of programmed on/off band, adjustable). The pump shall remain off until the discharge pressure reaches the start pressure (system set-point minus 50% of programmed on/off band, adjustable). Upon low flow shut-down a pump shall be restarted in one of the following two ways:

- A. **Low Flow Restart:** If the low flow condition still exists, the pump shall start and the speed shall again be increased until the stop pressure is reached and the pump shall again be switched off.

- B. Normal Flow Restart: If the pump system controller determines a low flow condition no longer exists the pump shall start and the speed shall be increased until the system pressure reaches the system set-point.

Low Flow Stop and Energy Saving Mode

The pump system controller shall be capable receiving a digital signal from a flow switch or an analog signal from a flow meter to indicate a low flow condition. A bladder type diaphragm tank shall be installed with a pre-charge pressure of 70% of system set-point. The tank shall be piped to the discharge manifold or system piping downstream of the pump system. When low flow is detected (signal from flow switch or meter), the system controller shall increase pump speed until the discharge pressure reaches the stop pressure (system set-point plus 50% of programmed on/off band). The pump shall remain off until the discharge pressure reaches the start pressure (system set-point minus 50% of programmed on/off band). The pump shall remain in the energy saving on/off mode during low flow indication. When low flow is no longer present (low flow indication ceases), the pump(s) shall resume constant pressure operation.

It shall be possible to change from the standard low flow stop to the optional low flow stop (and vice-versa) via the user interface.

2.07 SYSTEM CONSTRUCTION

- A. Suction and discharge manifold construction shall be in way that ensures minimal pressure drops, minimize potential for corrosion, and prevents bacteria growth at intersection of piping into the manifold. Manifold construction that includes sharp edge transitions or interconnecting piping protruding into manifold is not acceptable. Manifold construction shall be such that water stagnation cannot exist in manifold during operation to prevent bacteria growth inside manifold.
- B. The suction and discharge manifolds material shall be 316 stainless steel. Manifold connection sizes shall be as follows:
 - 3 inch and smaller: Male NPT threaded
 - 4 inch and larger: ANSI Class 150 rotating flanges
- C. Pump Isolation valves shall be provided on the suction and discharge of each pump. Isolation valve sizes 2 inch and smaller shall be nickel plated brass, or 316SS full port ball valves. Isolation valve sizes 3 inch and larger shall be a full lug style butterfly valve. The valve disk shall be of stainless steel or nylon coated. The valve seat material shall be EPDM and the body shall be cast iron or ductile iron, coated internally and externally with fusion-bonded epoxy.
- D. A spring-loaded non-slam type check valve shall be installed on the discharge of each pump. The valve shall be a wafer style type fitted between two flanges. The head loss through the check valve shall not exceed 5 psi at the pump design capacity. Check valves 1-1/2” and smaller shall have a POM composite body and poppet, a stainless steel spring with EPDM or NBR seats. Check valves 2” and larger shall have a body material of stainless steel or epoxy coated iron (fusion bonded) with an EPDM or NBR resilient seat. Spring material shall be stainless steel. Disk shall be of stainless steel or leadless bronze.
- E. Skid shall include a minimum 62 gallon ASME, 125 psig rated bladder type accumulator pressure tank to store excess pump pressure during low flow periods. The low flow accumulator tank shall be hard piped into the discharge of the booster system. Pressure tank shall be sized by the

manufacture for this specific application (see paragraph 2.01 A.); volume shall be as needed for smooth operation without excessive start/stops, etc.

- F. A pressure transducer shall be factory installed on the discharge manifold. Pressure transducers shall be made of 316 stainless steel. Transducer accuracy shall be +/- 1.0% full scale with hysteresis and repeatability of no greater than 0.1% full scale. The output signal shall be 4-20 mA with a supply voltage range of 9-32 VDC.
- G. A bourdon tube pressure gauge, 2.5 inch diameter, shall be placed on the suction and discharge manifolds. The gauge shall be liquid filled and have copper alloy internal parts in a stainless steel case. Gauge accuracy shall be 2/1/2 %. The gauge shall be capable of a pressure of 30% above its maximum span without requiring recalibration.
- H. Dry run protection for the booster pumps shall be provided with a liquid level switch installed on the suction manifold. Switch shall be 316SS wetted materials, 9-30VDC, 1A SPDT output, and rated up to 1000psig.
- I. The pumps shall be mounted on corrosion resistant 304 stainless steel. Rubber vibration dampers shall be fitted underneath each pump to minimize vibration. The booster skid, control panel, and pressure tank shall be full assembled, and wired on a formed base with a minimum 5" side wall, mounting flanges, and end caps of fabricated steel. Minimum base thickness shall be ½ inch with reinforcements on the underside. The Base shall be powder coated with an industrial grade powder coating in light grey color as standard.
- J. A Pressure Relief Valve is provided to prevent the pump from over pressurizing the process system. The PRV shall have a CPVC (Corzan) molded top and be sized per the drawing. The valve body shall be PVC and be of a two port flow through design, factory set at 50 PSIG (field adjustable 15-150 PSIG). Diaphragm is Teflon laminated and EPDM backed. The PRV shall relieve back to the distribution tank. Systems that relieve to drain are not acceptable.
- K. A 550 Gallon storage and distribution tank shall be provided as per the drawings. It shall be High-density linear polyethylene (HDLPE)*- natural white color complies with FDA Regulation 177.1520 and NSF/ANSI 61 standards. All materials are UV stabilized for long-term outdoor service and shall have molded in Gallons on the side of the tank. An adequately sized opening in the top will be installed for fill water and recirculation water from the PRV line, while maintaining the proper "Air Gap" required, (minimum of 2 x the inflow pipe diameter.)
- L. A tank fill valve shall be used to ensure that the distribution tank always has enough water to meet the needs of the system. The fill valve shall be Cla-Val Model 124-01. The float valve is a non-modulating valve that accurately controls the liquid level in tanks. This valve is designed to open fully when the liquid level reaches a pre-set low point and close drip-tight when the level reaches a preset high point. This is a hydraulically operated, diaphragm valve with the pilot control and float mechanism mounted on the cover of the main valve. The float positions the pilot control to close the valve when the float contacts the upper stop. The high and low liquid levels are adjusted by positioning the stop collars on the float rod. The difference between high and low levels can be adjusted to as little as one inch, or to as much as eighteen inches. Level settings can be as much as eleven and one half feet below the valve.
- N. A flexible expansion joint shall be required between the storage tank and the pressure booster system. Flexible joint shall be spherically molded with floating plated carbon steel flanges. Joints shall be Neoprene construction with nylon tire cord reinforcement.

- O. A rodent screen shall be provided to protect from rodent intrusion into the tank. Rodent screen shall be proposed by the manufacturer and shall be in accordance with all applicable Washington State Department of Health (DOH) requirements.

2.08 OVERALL SYSTEM OPERATION

The basis of operation for the Air Gap System is to maintain an adequate level of water in the distribution tank while providing the required flow and pressure to the process system. This shall be accomplished as follows:

- A. The distribution tank shall be filled with plant or city water using the pressure and flow available on site. Backflow prevention is accomplished through the use of a positive air gap at the top of the distribution tank. The Air Gap shall be a minimum of 2 x the fill line diameter at the distribution tank. No screens, splash containment or other obstructions that could cause backflow into the incoming water source shall be used at the distribution tank. A rodent screen shall be provided meeting DOH requirements shall be provided and installed (see paragraph 2.07 O.).
- B. A right angle, float actuated fill valve is used at the top of the distribution tank and will be mounted at least 2 x its discharge diameter above the distribution tank. An integral float connected to the fill valve will hang down into the distribution tank. This float will hydraulically actuate the valve, opening or closing based on the level in the tank. Fill valve shall include a flow straightener to prevent splashing.
- C. The process pump shall take suction through a bulkhead fitting installed in the distribution tank. It shall be adequately sized to provide the proper flow and pressure required by the system. It shall be a vertical multistage inline pump with integral VFD. The pump will maintain pressure in the process system by ramping up or down in speed based on the pressure reading from the discharge pressure transducer, as controlled by the system control panel.
- D. If something downstream of the pump changes the system to an over pressurized state, a PRV is in place to direct flow back to the distribution tank. This will prevent damage to equipment downstream of the pump in the process.
- E. An overflow line shall be installed above the max fill line on the distribution tank. In the event that the inflow does not shut off, the overflow line will direct the excess water to drain. There will be no isolation valve in this drain line.

3.00 EXECUTION

3.01 INSTALLATION:

The packaged water pressure booster system shall be installed in accordance with manufacturer's recommendations and as shown on the Drawings. Installation shall be by qualified personal thoroughly experienced in installation of cross connection control systems.

3.02 TESTING AND FIELD SERVICES

The packaged booster pump system shall be tested at the factory as a complete unit. The system shall be operated across the complete flow range (both single pump operation and duplex operation) to assure proper control sequence and operational stability. All control and alarm functions shall be simulated as part of the factory testing. Certified component testing in lieu of complete package testing is not acceptable.

The pump station supplier shall provide the services of a factory trained service technician for startup and adjustment of the system.

- A. Booster pump skid shall as a minimum be factory tested for functionality and documented results of functionality test supplied with pump skid

Functionality testing shall include the following parameters:

1. Complete System Hydrostatic Test – 1.5 times the nameplate maximum pressure
2. No-Flow Detection Shutoff Test
3. Water Shortage Test
4. Two-Point Setpoint Performance Test.
5. Integration into the WWTP SCADA system

- B. Each assembled Air Gap System shall be factory performance tested as a unit prior to shipment. The performance test shall consist of five (5) points over the operating range of the system. One point will be the specified primary design point of the pump. Verified test data will include head vs. capacity, motor output amps, motor frequency.

- C. Programming shall be entered into the Integral VFD prior to shipment (details of installation requirements shall be communicated to the pump system manufacturer). A performance test report shall be made available from the system manufacturer.

- D. The system shall undergo a maximum hydrostatic test of 1.5 x the working pressure of the system or up to the pressure limit of the components in the system for a minimum of 15 minutes prior to shipment.

4.00 MEASUREMENT AND PAYMENT

4.01 GENERAL:

- A. See Section 01 22 00 – Measurement and Payment for General Requirements. See Section 01 01 00 – Special Requirements/Bid Items for possible modifications to Standard Bid Items.
- B. If no specific bid item is provided, measurement and payment shall be considered incidental and shall be included in the bid price for other items of work for the project.

4.02 BID ITEMS:

A. **Cross Connection Control System**

1. Included shall be designing, furnishing and installing the cross connection control system and appurtenances. Payment shall be limited to 80% until the equipment has passed all acceptance testing requirements and O&M manuals have been submitted and approved.
2. Payment shall be on a Lump Sum (L.S.) basis.

****END OF SECTION****

1.00 GENERAL

1.01 DESCRIPTION OF WORK:

- A. Work covered by this section consists of designing, furnishing, and installing steel framed metal building systems generally using profiled and pre-coated metal roofing and siding. Work also includes engineering and furnishing all labor, material, and equipment required to design and construct concrete foundations for metal building as indicated.
- B. Metal building design shall be in accordance with all applicable local, state, and federal standards including reference standards herein, and shall be in accordance with all building codes and requirements for this specific location. Requirements herein are minimums. In the event of a conflict between this specification and applicable codes or standards, the more stringent standard shall apply.
- C. Contractor shall obtain all permits are required permits including the building permit (see Section 01 01 00). All design information, drawings, submittals, etc. for permit acquisition, including modifications to address comments, shall be included and are the sole responsibility of the Contractor.
- D. Metal roofing shall be standing seam in accordance with Section 07 61 13. All metal standing seam roofing shall be of the same type and manufacture.

1.02 SUBMITTALS:

- A. Submit the following in accordance with Section 01 33 00 of the Specifications.
 - 1. Shop Drawings
 - a. All shop drawings shall be stamped by a professional engineer licensed in the State of Washington.
 - b. Shall include erection drawings and erection manuals showing complete erection layouts, installation instructions, and details of connections. Details and layout shall show the steel framing location, lengths, and marking of panels and other component parts to correspond with sequence and procedure for erection. Shop drawings shall show connections with adjoining work.
 - c. Template for anchor bolts
 - 2. Product Data
 - a. Pre-engineered metal building materials: Submit sufficient data indicating conformance to specified requirements on materials provided under this section.
 - 3. Samples
 - a. Factory color finish: Submit one sample of each color indicated for verification that the color matches the colors indicated. Where colors are not indicated, submit not less than four different samples of manufacturer's standard colors for selection by the Owner's representative.
 - 4. Design Data and Calculations
 - a. All data and calculations shall be stamped by a Professional Engineer licensed in the State of Washington.

- b. Building primary and secondary framing system
 - c. Anchor bolts
 - d. Purlins and girts
 - e. Bracing
5. Foundation and Footing Loads and Reactions
- a. The pre-engineered metal building manufacture shall submit complete foundation loads and reactions to verify foundation, footing, and pier sizes and reinforcement.
6. Test Reports
- a. Factory Color Finish
 - b. Insulation
7. Certificates
- a. Pre-engineered metal building materials: Submit certificates attesting that materials comply with this specification.
8. Operation and Maintenance Data
- a. Pre-engineered building, data package: Submit operation and maintenance data.
- 1.03 REFERENCES AND STANDARDS:
- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. Design of the pre-engineered metal building shall be in conformance to all the latest edition of the references listed and all applicable design codes and guidelines.
- B. INTERNATIONAL BUILDING CODE
- C. AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)
- 1. AISC FCD Quality Certification Program Description
 - 2. AISC S329 Allowable Stress Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts
 - 3. AISC S335 Structural Steel Buildings Allowable Stress Design and Plastic Design
- D. AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)
- 1. ASCE 7-10 Minimum Design Loads for Buildings and Other Structures
- E. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
- 1. ASTM A 36/A 36M Carbon Structural Steel
 - 2. ASTM A 500 Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

3. ASTM A 529/A 529M High-Strength Carbon-Manganese Steel of Structural Quality
 4. ASTM A 572/A 572M High-Strength Low-Alloy Columbium-Vanadium of Structural Steel
 5. ASTM A 588/A 588M High-Strength Low-Alloy Structural Steel with 50 ksi (345 MPa) Minimum Yield Point to 4 in. (100 mm) Thick
 6. ASTM A 653/A 653M Sheet Steel, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 7. ASTM B 117 Operating Salt Spray (Fog) Apparatus
 8. ASTM B 221M Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)
 9. ASTM B 221 Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
 10. ASTM C 236 Steady-State Thermal Performance of Building Assemblies by Means of a Guarded Hot Box
 11. ASTM D 522 Mandrel Bend Test of Attached Organic Coatings
 12. ASTM D 523 Specular Gloss
 13. ASTM D 828 Tensile Properties of Paper and Paperboard Using Constant-Rate-of-Elongation Apparatus
 14. ASTM D 968 Abrasion Resistance of Organic Coatings by Falling Abrasive
 15. ASTM D 2244 Calculation of Color Differences from Instrumentally Measured Color Coordinates
 16. ASTM D 2247 Water Resistance of Coatings in 100 Percent Relative Humidity
 17. ASTM D 2794 Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
 18. ASTM D 3359 Measuring Adhesion by Tape Test
 19. ASTM D 4214 Evaluating Degree of Chalking of Exterior Paint Films
 20. ASTM E 84 Surface Burning Characteristics of Building Materials
 21. ASTM E 96 Water Vapor Transmission of Materials
 22. ASTM G 23 Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials
- F. AMERICAN WELDING SOCIETY (AWS)
1. AWS D1.1 Structural Welding Code – Steel

G. METAL BUILDING MANUFACTURERS ASSOCIATION (MBMA)

1. MBMA Low Rise Manual Low Rise Metal Building Systems Manual

H. UNDERWRITERS LABORATORIES (UL)

1. UL 580 Uplift Resistance of Roof Assemblies

1.04 DESCRIPTION OF BUILDING:

- A. Dimensions: Building dimensions shall be as standard with manufacturer, not less than those indicated, but exceeding the indicated dimensions only by the amount of the closest standard size thereto. Eave height shall be measured from the top of finished floor to intersection of insides of roof and sidewall sheets. The clear height between finished floor and bottom of roof steel shall be as indicated.
- B. Framing: Provide building with vertical walls and monoslope roof. Building shall be single-span structures or rigid frame type, similar to AISC S335, Type I construction. End walls shall be of rigid frame or beam and column design. Roof slope shall be as shown on the drawings. Package is to include framed opening for all doors and other openings as shown on the drawings. Package shall also include awnings above doors as shown on the drawings.

1.05 EXPERIENCE:

- A. The manufacturer shall have AISC FCD, category MB certification.
- B. Erector shall have specialized experience in the erection of metal building systems for a period of at least 5 years.

1.06 DESIGN REQUIREMENTS:

- A. MBMA's Metal Building Systems Manual, for loading combinations and definitions with the exceptions of wind load and special collateral loads. Design for each material shall be as specified by the Design Authority as listed in MBMA Metal Building Systems Manual.

B. Roof Loads

See General Structural Notes on the Drawings. Unless noted otherwise dead load is to include self weight of all framing members, insulation and sheeting. Design purlins to accommodate concentrate loads of 200 pounds, located at support points of overhead doors.

Basic Roof Snow Load = 103 psf

Other Loads as indicated.

- C. Wind Loads: See General Structural Notes on the Drawings. Compute and apply wind pressures, ASCE 7-10.

- D. Seismic Loads: See General Structural Notes on the Drawings.

E. Deflection

1. Structural Members: See General Structural Notes on the Drawings.
2. Roof Panels: UL 580, Class 90. The design analysis shall establish that the roof when deflected under dead plus live or snow loads, will not result in a negative gradient.

Maximum deflections shall be based on sheets continuous across two or more supports with sheets unfastened and fully free to deflect. In addition, the roof decking shall be designed for a 200-pound concentrated load at midspan on a 12-inch wide section of deck. Panels thinner than 0.03 inches are not permitted for diaphragms used to resist wind or seismic loads.

3. Wall panels: The maximum deflection due to wind on wall panels shall be limited to 1/180th of their respective spans.
4. Openings: Limit deflections of steel framing above and along the side of rolling door openings to a maximum of 1/2 the allowable movement in the telescoping top roller of the doors to ensure proper operation. Frame all equipment openings over 12 by 12 inches in size.

1.07 DELIVERY, STORAGE, AND HANDLING:

- A. Delivery: Deliver primary frames, secondary framing, panels, trim, flashing, accessories, bolts, nuts, washers and other erection hardware in building manufacturer's unopened packs and containers identified with building manufacturer's name and contents of each carton or pack.
- B. Storage: Store materials off ground and protect from damage. Slope galvanized secondary material and panel packages to avoid moisture accumulation and provide drainage.
- C. Handling: Handle material properly to protect from damage.

1.08 WARRANTY:

- A. Provide warranty against water leaks arising out of or caused by ordinary wear and tear by the elements for a period of 20 years. Such warranty shall start upon final acceptance of the work or the date the Owner takes possession, whichever is earlier.

1.09 QUALITY ASSURANCE:

A. Drawings: Pre-engineered Building

1. Submit complete design drawings for the pre-engineered building. Submit anchorbolt sizes and configuration and loads and reactions for the foundation, footing, and pier sizing. Drawings shall be stamped by a Professional Engineer licensed in the State of Washington.

B. Design Data: Building

1. Submit design calculations for the entire pre-engineered building and foundation load and reactions, prepared and stamped by a Professional Engineer licensed in the State of Washington. Also submit for components requested, and stamp with the seal of a Professional Engineer licensed in the State of Washington. Include sizes and location of anchor bolts.

2.00 PRODUCTS

2.01 WALL AND ROOF MATERIALS:

A. MBMA Low Rise Manual except as specified otherwise herein. Design roof and wall panels, accessories, and flashings to be completely weathertight and free of abrasions, loose fasteners, and deformations.

1. Minimum Thickness: As required to conform to design requirements but not less than the following:

Items	Minimum Thickness (Uncoated)
Steel Structural Members Other Than Roof and Wall Panels	18 Manufacturer's Standard (MFG STD) gage, 0.0478 inch
Roof Ventilators Steel	26 MFG STD gage, 0.0179 inch
Girders and Columns	3/16 inch web & 5/16" flange
Purlins and Girts	14 Manufacturer's Standard gage (MFG STD)
Roof Panels Steel	22 MFG STD gage, refer to specification 07 61 13
Wall Panels Steel	24 MFG STD gage
Bracing	3/16 inch thick steel members
Column Base Plates	5/8 inch thick
Column Anchor Bolts	5/8 inch diameter
Gable and Eave Trim, Fascia Closure Strips, Rake Flashings, Copings, and Liner Panels Steel	24 MFG STD gage
Eave Gutters and Downspouts Steel	24 MFG STD gage
Louvers Steel	18 MFG STD gage, per div 15

2.02 FRAMING AND STRUCTURAL MEMBERS:

A. Steel: ASTM A 36/A 36M, ASTM A 529/A 529M, ASTM A 572/A 572M, or ASTM A 588/A 588M.

B. Structural Tube: ASTM A 500 or ASTM B 221M ASTM B 221.

C. Secondary Framing Members: ASTM A653, grade D, structural quality, G-60 galvanized.

2.03 MISCELLANEOUS ITEMS:

- A. Caps, Strips, and Plates: Form ridge caps, eave and edge strips, fascia strips, miscellaneous flashings, and miscellaneous sheet metal accessories from the same manufacture, material and gage as the roof panels and shall be installed per manufacturer's recommendations. Wall plates, base angles or base channels, and other miscellaneous framing members may be standard structural steel shapes, or may be formed from steel not lighter than 18 gage thick.
- B. Closure Strips: Provide closure strips of closed-cell or solid-cell synthetic rubber or neoprene, or polyvinyl chloride premolded to match configuration of the covering. Closure strips shall not absorb or retain water.
- C. Sealant: Provide elastomeric type sealant containing no oil or asphalt. Exposed sealant shall cure to a rubberlike consistency. Concealed sealant may be the nonhardening type.
- D. Gaskets and Insulating Compounds: Provide nonabsorptive gaskets and insulating compounds suitable for insulating contact points of incompatible materials. Insulating compounds shall be nonrunning after drying.
- E. Fasteners: Provide fasteners for steel wall and roof panels of zinc-coated steel, aluminum, corrosion resisting steel, or nylon capped steel, type and size specified below or as otherwise approved for the applicable requirements. Fasteners for structural connections shall provide both tensile and shear strength of not less than 750 pounds per fastener. Fasteners for accessories shall be the manufacturer's standard. Exposed roof fasteners shall be gasketed or have gasketed washers on the exterior side of the covering to waterproof the fastener penetration. Washer material shall be compatible with the covering; have a minimum diameter of 3/8 inch for structural connections; and gasketed portion of fasteners or washers shall be neoprene or other equally durable elastomeric material approximately 1/8 inch thick. When wall covering is factory color finished, exposed wall fasteners shall be color finished or provided with plastic color caps to match the covering. Nonpenetrating fastener system using concealed clips shall be manufacturer's standard for the system provided.
 - 1. Screws: Provide self-tapping screws not less than No. 14 diameter and not less than No. 12 diameter if self-drilling/self-tapping type.
 - 2. End-Welded Studs: Provide automatic shouldered type studs with a shank diameter of not less than 3/16 inch and cap or nut for holding covering against the shoulder.
 - 3. Explosive Actuated Fasteners: Fasteners for use with explosive actuated tools shall have a shank diameter of not less than 0.145 inch with a shank length of not less than 1/2 inch for fastening panels to steel and not less than one inch for fastening panels to concrete.
 - 4. Blind Rivets: Provide stainless steel rivets with 1/8 inch nominal diameter shank. Rivets shall be threaded stem type if used for other than the fastening of trim. Provide hollow stem rivets with closed ends.
 - 5. Bolts: Provide bolts not less than 1/4 inch diameter, shouldered or plain shank as required, with nuts.

2.04 CONTINUOUS (RIDGE) ROOF VENTILATORS:

- A. Provide ventilators fabricated of zinc-coated steel or aluminum-zinc alloy coated steel, of manufacturer's standard factory finish, color as indicated, complete with braces, chain-operated

dampers, and bird screening. Provide ventilators in sections 8 or 10 feet long, braced at midlength. Join sections together with splice plates of the same material as the sections. Provide end closures for each section.

2.05 EXHAUST FANS AND LOUVERS:

- A. Provide exhaust fans, louvers and frames of the sizes and design indicated.

2.06 INSULATION:

See Section 07 00 00 Pre-Engineered Metal Building Thermal and Moisture Barriers.

2.07 DOORS AND WINDOWS:

- A. Provide doors and windows as specified in Division 8 of this Specification. Provide framing members and flashings as necessary for installation of the doors and windows.

2.08 CANOPIES:

- A. Of same materials and finish as the building. Soffit materials shall be of material indicated.

2.09 FINISH:

- A. Shop Painting: Ferrous metal work, except factory-finished work, zinc-coated work, aluminum-coated work, and work specified to be painted herein, shall be (1) cleaned of dirt, rust, scale, loose particles, grease, oil, and other deleterious substances; (2) phosphate treated; and (3) then be given one coat of an approved rust-inhibiting primer paint of the type standard with the metal building manufacturer.

- B. Factory Color Finish: Provide exterior and interior exposed surfaces of metal roof and wall panels, roof ventilators, louvers, gutters, downspouts, and metal accessories with a thermal-cured factory finish. Color shall be selected from manufacturer's standard colors. Provide an exterior finish top coat of the building manufacturer's standard paint. Provide standard dry film thickness of 1.0 mil for exterior coating exclusive of primer. Provide exterior primer thickness standard with building manufacturer. Interior color finish shall consist of the same coating and dry film thickness as the exterior. Provide interior and exterior color finish meeting the test requirements specified below. Tests shall have been performed on the same factory finish and thickness provided.

1. Salt Spray Test: ASTM B 117, minimum 500 hours. Undercutting of the paint film from the score line shall not exceed 1/16 inch.
2. Accelerated Weathering Test: ASTM G 23, Method 2, Type D apparatus minimum 2000 hours or Type EH apparatus minimum 500 hours, no checking, blistering or loss of adhesion; color change less than 5 NBS units by ASTM D 2244 and chalking less than No. 8 rating by ASTM D 4214.
3. Flexibility: ASTM D 522, Method A, 1/8 inch diameter, 180 degree bend, no evidence of fracturing to the naked eye.
4. Adhesion: ASTM D 3359, Method B, for laboratory test and film thickness less than 5 mil and Method A for site tests. There shall be no film removed by tape applied to 11 parallel cuts spaced 1/8 inch apart plus 11 similar cuts at right angles.

5. Impact: ASTM D 2794, no loss of adhesion after direct and reverse impact equal to 1.5 times metal thickness in mils, expressed in inch-pounds.
6. Humidity Resistance: ASTM D 2247, 1000 hours, no signs of blistering, cracking, creepage or corrosion on score panel.
7. Specular Gloss: ASTM D 523, finished surfaces exposed to the building exterior shall have a specular gloss of 10 measured at an angle of 85 degrees.
8. Abrasion: ASTM D 968, Method A, falling sand shall not expose substrate when tested in quantities 13.2-15.9 gallons of sand per mil of thickness.

3.00 EXECUTION

3.01 INSPECTION:

- A. Check concrete dimensions, anchor bolt size and placement, and slab elevation with the metal building manufacturer's templates and drawings before setting any steel.

3.02 ERECTION:

- A. Erect in accordance with the manufacturer's approved erection instructions and diagrams. Correct defects and errors in the fabrication of building components in a manner approved by the Owner's representative. If defects or errors in fabrication of components cannot be corrected, remove and provide nondefective components. When installing wall and roof systems, install closure strips, flashing, sealing material, and other accessories in accordance with building manufacturer's instructions to provide a weathertight system, free of abrasions, loose fasteners, and deformations. After erection is complete, repair and coat abraded and damaged, primed or factory-finished surfaces to match adjacent surfaces.

1. Dissimilar Materials: Prevent direct contact between aluminum surfaces, and ferrous or other incompatible metals, by one of the following methods:
 - a. Paint the incompatible metal with a coating of manufacturer's standard heavy-bodied paint.
 - b. Paint the incompatible metal with a prime coat of corrosion inhibitive primer followed by one or two coats of aluminum metal-and-masonry paint, or other suitable protective coating, excluding products containing lead and chromium pigmentation.
 - c. Provide an approved nonabsorptive gasket.
 - d. Apply an approved caulking between the aluminum and the incompatible metal.

If drainage from incompatible metal passes over aluminum, paint the incompatible metal by method (a) or (b). Paint aluminum surfaces in contact with concrete or masonry materials by method (a). Paint green or wet wood, or wood treated with incompatible wood preservatives, by method (a) or use two coats of aluminum paint.

2. Rigid Frames, Bases, and Sill Members: Brace frames as necessary to ensure safety. Set accurately, using a nonshrink grout to obtain uniform bearing on the concrete and to maintain a level base line elevation. Clean surfaces to receive the mortar and thoroughly

moisten immediately before placement of mortar. Water cure exposed surfaces of mortar with wet burlap for 7 days.

- a. Field Welding: Steel, AWS D1.1. Aluminum, AA 30.
 - b. Field Bolting: AISC S329
3. Wall Construction: Apply panels full wall heights from base to eave with no horizontal joints except at the junctions of door frames, window frames, louver panels, and similar locations. Lay side laps away from the prevailing winds. Seal side and end laps with the joint sealing material recommended by the manufacturer. Flash or seal walls at the base, at the top, around windows, door frames, framed louvers, and other similar openings. Flashing will not be required where approved "self-flashing" panels are used. Minimum end laps for all types of panels shall be 2 1/2 inches. Minimum side laps for all types of panels shall be one corrugation, one configuration, or an interlocking joint. Install liner panels to 8 feet above finished floor.
4. Roof Construction: Install panels in accordance with manufacturer's instructions and recommendations. Anchor securely in place using clip and fasteners specified in accordance with manufacturer's recommendations for design wind load criteria and in conformance with div 7 of these specifications. Flash and seal the roof at the ridge, at eaves and rakes, at projections through the roof, and elsewhere as necessary.
5. Minimum Fastener Spacing: Space fasteners according to manufacturer's instructions, but not to exceed:
- a. 8 inches o/c. at end laps of covering,
 - b. 12 inches o/c. at connection of covering to intermediate supports,
 - c. 12 inches o/c. side laps of roof coverings, 18 inches o/c. at side laps of wall.
6. Installation of Insulation
- a. Shall be in accordance with manufacturer's recommendations.
 - b. Roof Insulation: Install over purlins before roof coverings are applied. Hold insulation rigid until secured in place. Insulation facing shall be exposed on the interior side of the building. Fold and staple facing tabs of insulation on 6 inch centers, from exterior side of building to completely seal joints. If folding and stapling can only be accomplished from the inside, push the tabs neatly up between the edges of adjoining blankets and cover side laps of insulation with metal strips formed for this purpose and paint to match the facing material. Install the strips spanning from purlin to purlin and in accordance with the metal building manufacturer's recommendations.
 - b. Wall Insulation: Install over girts before wall coverings are applied. Hold insulation rigid until secured in place. Expose facing toward the interior side of the building. Fold and staple facing tabs of insulation on 6 inch centers, from exterior side of building, to completely seal joints. If folding and stapling can only be accomplished from the inside, push the tabs neatly up between the edges of adjoining blankets and cover side laps of insulation with metal strips formed for this purpose and paint to match the facing material. Install the strips spanning

from girt to girt and in accordance with the metal building manufacturer's recommendations.

3.03 FIELD PAINTING:

- A. Immediately upon detection, abraded or corroded spots on shop-painted surfaces shall be wire brushed and touched up with the same color and material used for the shop coat. Refer to Section 09900 of this Specification or manufacturer recommendation for painting of shop-primed ferrous surfaces exposed on the outside of the building and all shop-primed surfaces of doors and windows.

3.04 FIELD QUALITY CONTROL:

- A. At the discretion of the Owner's representative, sample panels may be taken at random from each delivery or from stockpiles on the site at any time during the construction period, and tests may be made to check the conformance of the materials to the requirements specified in paragraph entitled "Factory Color Finish." Failure of the sample sheets to pass the required tests shall be cause for rejection of all sheets represented by the samples and replacement of the entire shipment.

END OF SECTION

1.00 GENERAL

1.01 DESCRIPTION OF WORK

- A. This section is an extension of General Requirements and contains items of a common or administrative nature that pertain to all mechanical work.
- B. Special provision, requirements, and/or revision to Division 15 specifications and/or bid items may be included in section 01 01 00 (green pages) and/or on the drawings or details. This applies to all equipment and materials specified in Division 15.
- C. Some of the equipment specified in Division 15 is listed in Division 1 as base bid equipment items. See bidder's instructions in Division 1 for bidding base bid equipment. See section 01 25 00 for instructions for having alternate equipment considered.

1.02 QUALITY ASSURANCE

- A. Requirements of regulatory agencies: Comply with all applicable codes, rules and regulations.
- B. References: Comply with reference standards as listed in the specifications.
- C. Code Compliance: Comply with most current adopted edition of following:
 - 1. International Building Code (IBC), Standards and Amendments.
 - 2. International Mechanical Code (IMC), Standards and Amendments.
 - 3. International Fire Code (IFC), Standards and Amendments.
 - 4. International Plumbing Code (IPC), Standards and Amendments.
 - 5. National Electrical Code (NEC); NFPA 70.
 - 6. Applicable State and local codes, laws and ordinances.
- D. Fees and permits: Obtain required permits necessary to execute the work under this division. See Division 1 General Requirements for additional information related to permits.
- E. All pressure vessels, safety devices, and appurtenances shall comply with standards of and bear stamp of ASME.
- F. All electrical devices and wiring shall comply with standards of NEC. All devices shall be UL listed and so identified.

1.03 DRAWINGS

- A. Drawings are diagrammatic and show the general design, arrangement and extent of the systems. Do not scale drawings for roughing in measurements, nor use as shop drawings. Make field measurements and prepare shop drawings as required. Coordinate work with shop drawings of other specification divisions.

- B. Drawings and Specifications supplement each other and any details contained in one and not the other shall be included as if contained in both. Items not specifically mentioned in the specifications or noted on the drawings, but which are obviously necessary to make a complete working installation shall be included.

1.04 SUBMITTALS

- A. Detailed submittal requirements are given in the individual sections and Section 01 33 00, Submittals.
- B. Contractor shall investigate the capacity and space requirements of the proposed equipment before submitting shop drawings.

1.05 PRODUCT HANDLING

- A. Contractor is responsible for protection of all material, equipment and apparatus provided under this section from all damage both in storage and when installed, until final acceptance.
- B. Provide temporary storage facilities for material and equipment. Provide heat for equipment storage as recommended by manufacturer.
- C. Any material, equipment or apparatus damaged because of improper storage or protection will be rejected and any repair or replacement will be at no cost to the Owner.

1.06 CLOSEOUT SUBMITTALS

- A. See Division 1 for requirements.

1.07 GUARANTEE

- A. Guarantee satisfactory operation of material and equipment installed under Division 15. Repair or replace any defective materials, equipment, or workmanship which may show itself within one year from date of Substantial Completion.

2.00 MATERIALS

2.01 GENERAL

- A. The materials required for Division 15 are specified in the individual sections.

3.00 EXECUTION

3.01 GENERAL

- A. All equipment shall be installed in accordance with manufacturer's recommendations unless specifically directed by the Engineer otherwise.

3.02 SLEEVES AND INSERTS

- A. Contractor shall be responsible for locating and installing sleeves, inserts and supports as required during the stages of construction.

3.03 REVISIONS DURING INSTALLATION

- A. Contractor shall be responsible for making minor changes in the piping, ductwork and equipment locations due to structural obstructions or conflicts with work specified in other divisions.

****END OF SECTION****

1.00 GENERAL

1.01 DESCRIPTION:

- A. The work included in this Section consists of furnishing and installing a triplex non-clog submersible pump system for the sewage lift station, including three (3) submersible pumps with motor, discharge elbows, guide rails, guide rail supports, lifting chains, pump removal system, and all items, appurtenances and accessories required for a fully operationally system. If applicable, the work shall also include temporary sewage bypass pumping to maintain service.
- B. All materials and equipment shall be explosion proof to meet NEC class 1, division 1, groups C, D hazardous location requirements.
- C. Control panels and level control are specified elsewhere.
- D. Special provisions, requirements and/or revisions to this Specification and/or Bid Item(s) may be included in Section 01 01 00 (green pages) and/or on the Drawings or Details.

1.02 QUALITY ASSURANCE:

For the actual installation of the submersible pump system, the Contractor shall utilize only skilled personnel who are thoroughly experienced with the equipment and methods required for the installation.

1.03 SUBMITTALS:

Submittals shall conform to Section 01 33 00 of these Specifications, and shall include complete manufacturer's literature, drawings, installation instructions, operation and maintenance manuals and written warranties for all pumps, control panel and accessories generally as follows:

- 1. Pump Performance Curves.
- 2. Pump Outline Drawing.
- 3. Station Drawing for Accessories.
- 4. Electrical Motor Data.
- 5. Typical Installation Guides.
- 6. Technical Manuals.
- 7. Parts List.
- 8. Printed Warranty.
- 9. Management system certificate ISO 9001.
- 10. Manufacturer's Equipment Storage Recommendations.
- 11. Manufacturer's Standard Recommended Start-Up Report Form.

1.04 WARRANTY:

In addition to the guarantee specified in the General Conditions, all pumps and equipment shall carry the manufacturer's standard extended warranty against defects in material and workmanship under normal operation and service. The warranty shall be in writing and the terms thereof shall be at least equivalent to those of the specified pump manufacturer at the time of bid opening for the work. Minimum extended warranty shall be three (3) years.

1.05 PUMPING EQUIPMENT APPLICATIONS ENGINEERING:

NON-CLOG SUBMERSIBLE SEWAGE PUMP SYSTEM

The required pumping equipment shall be designed, selected and installed in accordance with the applications engineering recommendations of the pump, motor and VFD manufacturers, who shall review the application, design and specifications included herein and on the plans for conformance with such recommendations. If additional design or operating data is needed by the manufacturers for such review, it shall be the Bidder's responsibility to request same from the Engineer at least 15 working days prior to bid opening date.

2.00 PRODUCTS

2.01 SUBMERSIBLE PUMPS:

A. Pump and Motor Design

Each of the three (3) submersible pumps shall be capable of handling raw unscreened domestic sewage without clogging, and capable of passing a 3" sphere. Pumps shall be Flygt Concertor Submersible Pump(s) with Integrated Control System for wet well installation or approved equal. Approval of an alternate shall follow process outlined in Article 11 of the Instructions to Bidders.

Each pump shall be operated by a synchronous motor and an integrated control system and be capable to run at constant power at any point of the performance field without being overloaded.

Each pump shall be sized and selected by the manufacturer for this installation and meeting the performance requirements as follows:

	Flow (gpm)	TDH (ft)
Design Point	650	45
Number of pumps	3	
Pump Max Required HP: (over entire pump curve)	10 HP	
Discharge:	4" dia.	
Motor:	10 HP, 480 V, 3 PH, 60 hz	
Motor Notes:	See Electrical Specifications	

See Section 01 01 00 – Special Requirements/Bid Items for additional requirements.

B. Pump Construction

Each pump shall be of the sealed submersible type. Pump volute, motor and seal housing shall be high quality gray cast iron. All external mating parts shall be machined and O-ring sealed. All fasteners exposed to the pumped liquid shall be stainless steel.

The Materials of construction shall be as follows:

- Pump housing: ASTM A-48, Class 35B
- Impeller and insert ring: A 532 ALLOY III A (25% chrome)
- Stator housing: GD-AL SI 12 or ASTM B85A 413
- Shaft: ASTM A479 S43100-T.

NON-CLOG SUBMERSIBLE SEWAGE PUMP SYSTEM

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Shaft seal: Pump side: - Corrosion resistant Tungsten carbide WCCR

Shaft seal Motor side: - Corrosion resistant Tungsten carbide WCCR

All castings must be blasted before coating. All wet surfaces are to be coated with two-pack oxyrane ester Duasolid 50. The total layer thickness should be at least 120 microns. Zink dust primer shall not be used.

The pump shall be equipped with a semi open multi vane impeller designed to transport municipal wastewater.

The impeller blades shall be self-cleaning upon each rotation as they pass across a sharp relief groove in the Insert ring and shall keep the impeller blades clear of debris. The insert ring shall have a guide pin which moves fibers from the center of the impeller to the leading edges of the impeller. The impeller shall move axially upwards to allow larger debris to pass through and immediately return to normal operating position. The clearance between the insert ring and the impeller leading edges shall be adjustable.

C. Mechanical Seals

The shaft shall be sealed by a tandem mechanical shaft seal system consisting of two seals, each having an independent spring system. The seals shall require neither maintenance nor adjustment and shall be capable of operating in either clockwise or counter clockwise direction of rotation without damage or loss of seal function.

Where a seal cavity is present in the seal chamber, the area about the exterior of the lower mechanical seal in the cast iron housing shall have cast in an integral concentric spiral groove. This groove shall protect the seals by causing abrasive particulate entering the seal cavity to be forced out away from the seal due to centrifugal action.

The shaft seal material (pump and motor sides) shall be corrosion resistant Tungsten carbide WCCR.

D. Motor

The pump, the motor and the integrated control system shall be submersible a minimum of 65 feet (20m) according IEC 60034 and protection class IP 68. Motors which only can be submerged for a limited time (IP 67) shall not be considered as equal

The motor shall capable to operate the pump at continuous duty (S1) in an ambient temperature up to 104°F. Operational restrictions or the demand of auxiliary cooling systems like fans or blowers are not acceptable.

Motor shall be inverter duty rated with factory installed grounding rings.

See Electrical Specifications for additional requirements.

E. Power Cord

The motor shall be equipped with 30 feet of screened cable suitable for submersible pump applications. The power cable shall be sized according to NEC and ICEA standards. The outer

jacket of the cable shall be oil resistant chlorinated polyethylene rubber. The cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet.

The power cord shall be continuous from the motor to the explosion-proof J-Box or splice box as indicated on the Drawings.

See Electrical Specifications for additional requirements.

F. Stator Windings

The Stator shall be inverter duty rated in accordance with NEMA MG1, Part 31 and be insulated according class H (356°F).

See Electrical Specifications for additional requirements.

G. Pump Protection

The control system shall continuously monitor the leakage sensor in the stator housing and the temperature of the motor. It shall be impossible to overload the motor. If the motor temperature is too high, the pump shall continue to operate at reduced power until conditions are normalized. External trips or overload devices for motor protection shall not be required.

The operator shall be able to modify the setting of the control system to decide if the active leakage signal shall stop or not stop the pump.

See Electrical Specifications for additional requirements.

2.02 HYDRAULIC SEALING FLANGE:

Each pump shall be supplied with a mating cast iron discharge connection. Sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal to metal watertight contact. Sealing off the discharge interface with a diaphragm, O-ring or profile gasket shall not be acceptable. No portion of the pump shall bear directly on the wet well floor.

2.03 GUIDE RAIL:

- A. The pumps shall be automatically and firmly connected to the discharge connection, guided by no less than two stainless steel guide bars extending from the top of the station to the discharge connection to ensure pump stability when installing or removing the machine.
- B. The guide rail system shall consist of two parallel 2” guide bars, supported by pump manufacturer supplied upper guide rail brackets. Guide bars and guide brackets shall be type 304 Stainless Steel.
- C. The pump shall be automatically connected to the discharge connection elbow when lowered into place, and shall be easily removable for inspection or service. There shall be no need for personnel to enter the wet well. Sealing of the pumping unit to the discharge connection elbow shall be accomplished by a single down and in motion of the pump.

2.04 LIFTING CHAIN:

- A. Each pump shall be fitted with stainless steel lifting chain. Lifting chain shall be connected to the lifting handle of the pump and be long enough to reach the top elevation of the station. Lifting chain shall be compatible with the Grip-Eye Pump Lift System. The working load of the lifting system shall be 50% greater than the pump unit weight.
- B. One pump lift system Grip-Eye shall be provided for each pump station. The Grip-Eye shall allow for utilizing the hoist for lifting each pump from its installed position to above the top elevation of the station. The Grip-Eye device shall be configured to slide down the stainless steel lifting chain and grip the lifting chain near pump handle. The retrieval system shall be appropriately sized for the weight of the pump to be lifted.

2.05 DISCHARGE BASE ELBOW:

- C. A discharge base elbow shall be furnished for each pump. The discharge base elbow shall rest squarely on the floor of the pump well and be securely anchored to the floor. Units which require a separate concrete or fabricated structure in order to elevate the base elbow above the pump well floor will not be acceptable.
- D. The base elbow shall be equivalent to 4” steel piping in size. The elbow shall be 90 degree with a standard 125-lb flange faced and drilled on the outlet side and an inlet flange faced only.

2.06 PUMP ACCESS FRAME AND HATCH:

- A. A separate access frame assembly shall be supplied with a hinged door for removal of each pump. Access frame assembly and door shall be galvanized steel with steel hinges and hardware. The door shall be tread plate to provide a skid-proof surface. Frame opening dimensions shall be suitable for adequate removal and replacement of pumps, and as may be specified in Section 01 01 00. Load rating for the door and frame assembly shall be standard highway loading (HS-20 truck live load). The guide rail shall attach to the access frame assembly with 300 series stainless steel fasteners. A recessed, stainless steel handle shall be provided with each door. A safety latch to hold door in open position shall also be provided. Door shall be lockable with a recessed locking assembly. Frame and hatch shall be by Halliday or approved equal.
- B. If applicable, Contractor and pump supplier shall confirm that the existing hatch size and configuration is compatible with the specified pump system.

2.07 FLOAT MOUNTING BRACKET:

A level control float mounting bracket shall be provided. Float mounting bracket shall provide strain reliefs to hold level control cords and allow adjustment of level controls to desired pumping and alarm levels. Continuous cords are to run from pump(s) and level controls to the explosion-proof J-Box or splice box as indicated on the Drawings. No splices shall be made in wiring except in the explosion-proof J-Box or splice box as shown. Float mounting bracket shall be fabricated from FRP, stainless steel or aluminum. Float mounting bracket shall attach to concrete or hatch frame with 300 series stainless steel fasteners. Float mounting bracket shall be positioned so as not to interfere with pump removal and installation but shall be easily accessible from the pump hatch.

See Electrical Specifications for additional requirements.

2.08 PORTABLE HOIST SYSETM

A portable hoist system shall be sized/selected by the pump manufacturer for this specific application, and supplied by the Contractor. Hoist system shall include embed system socket compatible with Halliday products and DB stainless steel adjustable portable hoist. Hoist system shall be located as required to remove and replace pumps. Shall be able to drain water through designated weep hole. Structural design of the wetwell top shall include loads associated with the hoist system and pump removal. Hoist socket shall include stainless steel cap.

2.09 CONTROL PANEL:

See Electrical Plans and Specifications.

2.10 LEVEL CONTROLS:

See Electrical Plans and Specifications.

2.11 PROCESS CONTROL FOR WASTEWATER PUMP(S) WITH INTEGRATED PUMP CONTROL SYSTEM:

See Electrical Plans and Specifications.

2.12 CONTROL SYSTEM PERFORMANCE REQUIREMENTS:

Control system shall include all products, material, equipment, labor, appurtenances, etc. as required for a complete lift station capable of delivering clarified effluent to the tertiary treatment system for the full range of influent flows. Control system shall include level control, VFD, programming and equipment, determination of presets, emergency level indicators, alarms, and any and all work required for a fully functional triplex pump system and control system.

See Electrical Plans and Specifications.

2.13 SPARE PARTS:

Spare parts shall include all parts required for manufacturer recommended maintenance items for first 3 years of operational. Spare parts shall also include all specialty parts/items/tools required for pump/motor rebuild.

3.00 EXECUTION

3.01 EQUIPMENT INSTALLATION:

The pumping system shall be installed in the wet well in the position indicated on the Drawings and/or required by the manufacturer's literature and written instructions, and shall include installation of discharge elbows, guide rails, strainer basket (if specified), access hatches, level controls and control panel. The system when completed with piping, electrical and other work required shall make a complete and properly operating pumping system.

3.02 EXISTING PUMP SYSTEM, TEMPORARY BYPASS (IF APPLICABLE):

- A. The Contractor shall design, install and operate an adequate and reliable temporary pumping system to bypass the existing lift station if applicable. Such temporary system shall be subject to Engineer and Owner review. Schematic drawings, equipment descriptions, power source, and operating plan shall be submitted for Engineer and Owner review sufficiently in advance of the planned shut-down of the existing facility. Operating plan shall include monitoring and emergency plan to deal with equipment failure.
- B. The Contractor shall be solely responsible for the adequacy of the temporary bypass pumping system, and for its reliable operation.
- C. The Contractor shall coordinate and schedule bypass system installation, shut-down of the existing system and removal of the existing system with the Owner. The Contractor shall not shut down and remove the existing system until the Contractor's temporary bypass system and operating plan are complete, in place and operating adequately.

3.03 TESTING:

- A. The Contractor, with a representative of the manufacturer, shall start, test, and adjust the equipment for complete and satisfactory operation, and shall instruct a representative of the Owner in the operation and maintenance of the pumping system in the presence of the Engineer. All functions of the system shall be tested to the Engineer's satisfaction. The system shall be tested under simulated operating conditions when the lift station and force main are completed, by utilizing water furnished by the owner from the nearest fire or yard hydrant. The Contractor shall supply any hoses needed to get water to the lift station. The pump testing may be combined with power plant testing if possible. Length of pump testing shall be a minimum of two hours. The operational testing to be done shall include but is not limited to the following for each pump:
 - 1. Verify and/or correct pump rotation.
 - 2. Check discharge connection.
 - 3. Measure pump discharge and total dynamic head.
 - 4. Determine electrical current and voltage.
 - 5. Check all control functions and alarms.
 - 6. Demonstrate removal and replacement of pumps and basket (if specified).
- B. If any deficiencies are revealed during any test, such deficiencies shall be corrected and the tests shall be conducted again.
- C. Written results of all testing shall be recorded by the Contractor and provided to the Engineer. The Owner reserves the right to video tape all equipment testing and adjustment, as well as all instructions and training given for the operation and maintenance of the equipment.
- D. See Electrical Plans and Specifications for additional requirements.

4.00 MEASUREMENT AND PAYMENT

4.01 GENERAL:

The lump sum price bid for this work shall cover the cost of furnishing all labor, materials, equipment, tools, and incidental items required to complete the work in accordance with the Drawings and

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Specifications; any work, materials, or equipment not specifically mentioned as included, but which is required for its proper execution shall be considered to be included in the price bid.

4.02 BID ITEMS:

A. Special provisions, requirements, revisions to these Bid Items, and/or additional Bid Items, may be included in Section 01 01 00 (green pages) or on the Drawings or Details.

B. Submersible Pump System

1. Payment shall be based on a lump sum and no measurement is required. This Bid Item shall include furnishing and installing the submersible pump system complete in place in the wet well, including the discharge base elbow, also including furnishing pump panel and controls, pump and alarm system testing and demonstration, O&M manuals, and training of Owner personnel in the use of pump and alarm system. This Bid Item includes the wet well, valve vault, piping downstream of the discharge base elbow and electrical work, unless separate bid items are provided.
2. Payment for temporary bypass pump system (if applicable) is included in this Bid Item unless a separate Bid Item is provided.
3. This Bid Item shall include removal and disposal of the existing pump system and appurtenances, if applicable, and unless a separate Bid Item is provided, including all modifications and repairs to existing buildings or equipment as necessary for completion of the work.

****END OF SECTION****

1.00 GENERAL

1.01 DESCRIPTION:

- A. Work consists of selecting, furnishing and installing a complete heating and ventilation system as needed to heat and ventilate the structures shown on the drawings. System shall meet the minimum requirements specified herein and shown on the drawings. Heating and ventilation scope shall include all design, equipment, appurtenances, electrical, controls, and any other item needed for a complete and fully operational heating and ventilation system in accordance with all applicable codes, requirements, and good practice.
- B. Special provisions, requirements and/or revisions to this Specification and/or Bid Item(s) may be included in Section 01 01 00 (green pages) and/or on the Drawings or Details.

1.02 QUALITY ASSURANCE:

All work and materials shall meet the minimum requirements of national, state, and local codes. All controls and wiring shall also conform to the electrical specifications and requirements.

1.03 SUBMITTALS:

Submittals shall conform to Section 01 33 00 of these Specifications. Manufacturer’s documentation including: Name of manufacturer, type and model, design rotative speed, BHP, rated motor HP, performance characteristics including capacity and pressures, materials used, weight of assembled unit, list of accessories to be furnished with unit, finish, and voltage.

2.00 PRODUCTS

2.01 DUCTWORK:

- A. Sheet metal ducts and plenums shall be constructed with airtight joints and seams in accordance with the latest editions of ASHRAE standards and SMACNA Duct Construction Manual. Ductwork materials shall be aluminum, unless otherwise noted. Aluminum sheets shall be ASTM B209, Allow 303 temper H15 with mill finish. Minimum duct gages required are as follows:

Maximum Size of Ducts (inches)	Aluminum Thickness (inches)
12 or less	.025
13 through 30	.032
30 through 54	.040
55 through 60	.050

- B. Fabrication shall be airtight and shall include all necessary reinforcements, bracing, supports, framing, gasketing, sealing and fastening to provide rigid constructions and freedom from vibration.
- C. Removable bird screen shall be provided on all outside air intakes and exhaust air discharges to outside air. Screens shall be secured in frames of same metal as screens. Bird screens shall be ½-inch mesh x 14 gauge and shall be of same material and finish as duct, hook, louver or equipment to which the screens are attached.

2.02 CONTROLS:

A. General

All heating and ventilating equipment shall be provided with manual or automatic control systems unless otherwise shown on Mechanical and Electrical Drawings, or as specified below. Individual exhaust fans shall have manual switches for single or 2-speed motors unless otherwise shown. Electric unit heaters shall have unit-mounted contactors, unless otherwise shown, and they shall be controlled from wall-mounted thermostats.

B. Coordination with Electrical

The work under this section must be coordinated with the electrical work in order to accomplish the interfacing necessary to provide a complete and operable system.

C. Thermostats

Room thermostats shall be of the modulating electric type, except where 2-position action is required. Thermostats shall be located as indicated on the plans and shall have ranges to suit the site conditions. All thermostats shall have exposed adjustment dials and a thermometer on the front face. Mounting height shall be 5 feet unless noted otherwise, or requested by the Owner. An insulating back shall be provided where exterior wall mounting is indicated. Guards shall be provided for thermostats.

D. Manufacturers

Control system components and thermostats shall be as manufactured by Honeywell; Johnson Controls Company; General Controls; or equal.

2.03 FANS:

A. General

See other specifications including Section 23 34 23 Power Ventilators. Fan requirements herein supplement other specifications and are general in nature and shall supplement requirements outlined in other specifications including 22 34 23. Where a conflict exists the more stringent requirement shall apply.

All units shall be heavy duty, rated for continuous 24 hours per day service and of totally enclosed (waterproof) design. Fans shall be complete with motors, flexible connections to supply and/or suction ducts, vibration isolators, and necessary accessories. All exhaust fans shall be furnished with automatic back draft dampers. Belt-driven fans shall be complete with adjustable motor bases and belt guards. All exposed fan propellers located 8 feet or less above working floor elevation, or otherwise easily accessible, shall be provided with a finger-proof wire guard. All fan wheels shall be statistically and dynamically balanced and shall be free from objectionable vibration or noise.

B. Wall-Mounted Fans

1. Wall-mounted exhaust fans shall be direct motor-driven, unless otherwise shown, and shall be supported on metal frames for mounting, with safety guards. Wall openings shall be of sufficient size for the fan capacity. Fan weather hoods shall be provided and special provisions shall be provided for draining rain water away from walls to prevent stains or water streaks on hoods.
2. Direct driven fans shall be provided with TEFC motors and shall be Loren Cook ACW-D, or equal.

2.04 HEATERS:

A. General

Electric heaters shall be furnished and installed where shown and as specified herein. Heaters shall be controlled from wall-mounted thermostats furnished under this section. Heaters shall have built-in magnetic contactors and safety devices to meet UL listing, National Electrical Code, and local regulations. Heater capacity and size shall be as specified or shown on the Drawings.

B. Unit Heaters

Unless otherwise shown, all unit heaters shall be of the electric, horizontal discharge type, with enameled steel cabinet, mounting bracket, adjustable four-way louvers, spiral finned, enclosed heating element, automatic reset overheat protection, thermal protected, permanently lubricated fan and motor, fuses and contactors. Where unit heaters are supplied with wall-mounted low voltage thermostats, the heaters shall be equipped with control transformers. Electrical characteristics shall be in accordance with the Electric Drawings. Unless otherwise noted on the Drawing, all unit heaters shall be as manufactured by Chromalox or equal.

2.05 LOUVERS:

A. Exterior Wall Louvers

1. Where exterior wall louvers are required, they shall consist of two separate louvers. The first louver shall be a fixed blade louver for weather protection. Frame and blades shall be 6063TS extruded aluminum, 0.081” thick. Aluminum screen shall be provided.
2. Second louver shall consist of a counterbalanced backdraft damper. Frame shall be 6063TS extruded aluminum, 0.090” thick. Blades shall be 0.025” thick formed aluminum.
3. Finish for both louvers shall be clear anodized. Louvers shall be as indicated on the drawings or if not shown on the drawings, Ruskin Models ELF811 and CBD2, or approved equal.

B. Motor Operators

Where shown on the Drawings, louvers shall be equipped with motor operators which open and close. The louver operators shall have: two point (full open-full close) operation, cast aluminum housing, pre-wired, operates on 120V, 60 Hz power and be UL and CSA approved.

2.06 SEQUENCE OF OPERATION:

Sequence of operation for all HVAC systems shall be proposed by the Contractor for owner review/approval. Sequence of operation shall be as required to maintain building interior environments in accordance with all equipment manufacturer's requirements and in accordance with all applicable standards, requirements, regulations, and good practice.

3.00 EXECUTION

3.01 INSTALLATION:

A. General

1. Observe good common practice in locating and installing mechanical equipment and accessories so that completed installation presents the least possible hazard. Maintain adequate clearances to all fixtures, valves, and equipment so as to permit ready access to all parts requiring adjustments, inspection, service, and repair.
2. Follow equipment manufacturer's detailed instructions and recommendations in the installation and connection of all equipment. No equipment installation or connections shall be made in manner that voids the manufacturer's warranty.
3. Provide all required trim including sturdy and adequate bases or support systems, braces, supports, inserts, flashing, floor, ceiling and wall plates, valves, fittings, sleeves, accessories, etc., necessary for a complete installation.

B. Sheet Metal Work

1. All necessary allowances and provisions shall be made in the installation of sheet-metal ducts for the structural conditions of the structures. During the installation, the open ends of all ducts shall be protected to prevent debris and dirt from entering.
2. Hangers and supports shall conform to the SMACNA Duct Manual and the following: Ducts with cross-sectional areas up to 4 square feet shall have hangers spaced not more than 8 feet apart. Ducts between 4- and 10-square-foot areas shall have hangers spaced not more than 6 feet apart.
3. All ducts shall be sealed air tight. Where ducts connect to masonry openings, provide a continuous 2-inch by 2-inch by 1/8-inch galvanized angle iron from which shall be bolted to the construction and made airtight with caulking. Duct shall be fastened to the angle iron.

3.02 CLEANING AND TESTING:

- A. All equipment, duct work, and fixtures shall be thoroughly cleaned.
- B. All equipment shall be tested. Contractor shall demonstrate that all equipment works as intended.

4.00 MEASUREMENT AND PAYMENT

4.01 GENERAL:

- A. See Section 01 22 00 – Measurement and Payment for General Requirements. See Section 01 01 00 – Special Requirements/Bid Items for possible modifications to Standard Bid Items.
- B. If no specific bid item is provided, measurement and payment shall be considered incidental and shall be included in the bid price for other items of work for the project.

4.02 **BID ITEMS:**

- A. Special provisions, requirements, revisions to these Bid Items, and/or additional Bid Items, may be included in Section 01 01 00 (green pages) or on the Drawings or Details.
- B. Heating and Ventilating
 - 1. Included shall be the furnishing and installation of all heating and ventilating equipment, in conformance with these specifications and as shown on the construction drawings.
 - 2. Payment shall be on a Lump Sum (L.S.) basis.

****END OF SECTION****

1.00 GENERAL

1.01 DESCRIPTION OF WORK:

- A. Work consists of adjustment and balancing of Air Systems
- B. Special provisions, requirements and/or revisions to this Specification and/or Bid Item(s) may be included in Section 01 01 00 (green pages) and/or on the Drawings or Details.

1.02 2.00 QUALITY ASSURANCE:

- A. Testing Agency: The Contractor shall procure services of an independent Air Balance and Testing Agency which specializes in balancing and testing of heating and ventilating systems to balance, adjust, and test air moving equipment, air distribution, exhaust and control systems.
- B. Agency Qualifications: An Independent testing, adjusting, and balancing agency certified by Associated Air Balance Council (AABC) or by National Environmental Balancing Bureau (NEBB) in those testing and balancing disciplines required for this project.

1.03 STANDARDS:

- A. AABC: National Standards for Total System Balance
- B. NEBB: Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

1.04 SUBMITTALS:

- A. Shop drawings and product data sheet submittals shall conform to Section 01 33 00 of the Specifications.
- B. Indicate adjustment, balance, and equipment data required.
- C. Submit draft copies of report for review prior to final acceptance of project. Provide final copies for the Engineer and for inclusion in Operating and Maintenance Manuals.
- D. Provide reports in soft cover 3-ring binder manuals, complete with index page and indexing tabs and cover identification at front and side.
- E. Submit detailed procedures, agenda, sample report forms and copy of AABC/NEBB National Project Performance Guaranty prior to commencing system balance.
- F. Submit reports on NEBB or AABC National Standards for Total System Balance forms.

1.05 TEST REPORTS:

- A. Title Page: Company Name, Address, and Telephone Number; Project Name, Location, Architect, Engineer, and Project Contractor.
- B. Instrument List: Instrument, Manufacturer, Model, Specified and Actual Air Flow, Return Air Flow, Outside Air Flow, Static Pressure, and Fan RPM.

- C. Exhaust Fan Data: Location, Manufacturer, Model, Specified and Actual Air Flow, Static Pressure, and Fan RPM.
- D. Electric Motor: Manufacturer, HP/BHP, Phase, Voltage, Amperage, RPM, Service Factor, Starter Heater Elements.
- E. V-Belt Drive: Identification/Location, Driven Sheave Diameter and RPM belt Size and Quantity, Motor Sheave Diameter and RPM.
- F. Air Distribution Test: Terminal Number, Room Number/Location, Terminal Type and Size, Area Factor, Design Velocity and Air Flow, Test Velocity and Air Flow.

1.06 OPERATION AND MAINTENANCE DATA:

- A. Submit operation and maintenance data per the requirements of the specifications.
- B. Include certificates of approval and acceptance from authorities having jurisdiction.

2.00 PRODUCTS

Not used

3.00 EXECUTION

3.01 PREPARATION:

- A. Before adjusting and balancing, verify that systems are complete and operable. Ensure temperature control systems are complete and operable, thermal overload protection is in place, final filters installed, hydronic systems, flushed, filled, and vented.
- B. Provide instruments required for adjusting and balancing operations. Make instruments available to Engineer to facilitate spot checks during testing.
- C. Recorded data shall represent actually measured, or observed condition.

3.02 AIR SYSTEM PROCEDURES:

- A. Adjust air handling and distribution systems to provide required or design supply, return and exhaust air quantities. Permanently mark settings of damper and other adjustment devices allowing settings to be restored.
- B. The Contractor performing work under Division 15 and 23 shall make changes in pulleys, belts, and dampers or add dampers as required for correct balance as recommended by Air Balance and Testing Agency at no additional cost to Owner.
- C. Adjust air handling systems plus or minus 5 percent for supply systems and plus or minus 10 percent for return and exhaust systems from figures indicated.
- D. Measure air quantities at air inlets and outlets. Use volume control devices to regulate air quantities. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required.

- E. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- F. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.
- G. Adjusting & Balancing:
 - 1. Procedure: Air Balance Agency shall perform following tests and balance system in accordance with following requirements. All tests shall be performed for single speed systems. In addition, perform tests (a) through (d) at both high and low speeds for multi-speed systems.
 - a) Test and adjust blower rpm to design requirements.
 - b) Test and record motor full load amperes.
 - c) Make Pitot Tube traverse of main supply and obtain design cfm at fans.
 - d) Test and record system static pressures, suction, and discharge.
 - e) Test and adjust system for design cfm air.
 - f) Test and adjust system for design cfm outside air.
 - g) Test and record entering air temperatures.
 - h) Test and record leaving air temperatures.
 - i) Adjust main supply and return air ducts to proper design cfm.
 - j) Adjust zones to proper design cfm, supply and return.
 - k) Test and adjust each diffuser, grille, and register to within 10% of design requirements.
 - l) Identify each diffuser, grille, and register to location and area.
 - m) Identify and list size, type, and Manufacturer of diffusers, grilles, registers, and testing equipment. Use manufacturer's rating on equipment to make required calculations.
 - n) In readings and tests of diffusers, grilles, and registers, include required cfm and test cfm after adjustments.
 - o) In cooperation with Section 23 09 00, set adjustments of automatically operated dampers to operate as specified, indicated, or noted.
 - p) Adjust diffusers, grilles, and registers to minimize drafts.
 - q) Where air handling equipment supplied to job site provides up to 10% more air than schedule requirements, rooms supplied by that unit shall have their supply air quantities increased by the ratio of the actual total air quantity supplied to the minimum air quantity required by schedule.

3.03 VERIFICATION OF CONTROL SYSTEM:

- A. The Air Balance Agency, with the aid of the Control Contractor, shall verify that the control systems are performing in accordance to the specified criteria.

- B. Operation of all components and system sequence shall be verified and documentation of all system testing, adjusting, and balancing submitted to owner for review and included in the O&M manual. Letter of certification shall be forwarded to the Owner's Representative with copies enclosed in the O&M Manual.

- C. This procedure shall not relieve the control contractor of any responsibilities. This paragraph is intended to insure that the control system is completely operational and adjusted at the time the air systems testing and balancing is being accomplished. Adjust water systems to provide required or design quantities. Permanently mark settings of valves and other adjustment devices allowing settings to be restored. Set and lock memory stops.

****END OF SECTION****

1.00 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1, 15 and 23 Specification Sections apply to this Section.

1.02 MECHANICAL PROJECT CLOSEOUT

- A. Comply with closeout requirements specified elsewhere, in addition to any specific requirements of this Section.

1.03 SCOPE OF WORK

- A. Furnish and install all control equipment, engineering services, job drawings and field supervision for automatic temperature control systems described in this Section and/or indicated on the Drawings, and as needed for fully functional heating and ventilation system for the structures shown on the Drawings. This shall include all equipment, accessories, appurtenances, control items, electrical, etc., whether shown or not shown on the Drawings, needed for a fully functional and operational system, and shall be included in the amount bid.
- B. Provide assistance as required for DDC System adjustments, manipulation of operational sequences, etc. for HVAC systems balancing.

1.04 SERVICE AND GUARANTEE

- A. The temperature control system(s) as herein specified shall be free from defects in workmanship and material under normal use and service. If within one (1) year from date of Acceptance by the Owner, any of the equipment herein described is proved to be defective in workmanship or material, it shall be replaced or repaired at no expense to the Owner.
- B. The Contractor shall, after completion of the original test of the installation and Acceptance by the Owner, provide any service incidental to the proper performance of the temperature control system under guarantees outlined above for the period of one (1) year, after completion of the installation, the Contractor shall regulate and adjust all equipment provided.

1.05 CODES AND STANDARDS

- A. Electrical Standards: Provide electrical products which have been tested, listed and labeled by UL and comply with NEMA standards.
- B. NEMA Compliance: Comply with NEMA standards pertaining to components and devices for electric control systems.
- C. NFPA Compliance: Comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" where applicable to controls and control sequences.

1.06 SUBMITTALS AND SHOP DRAWINGS

- A. Shop Drawings: Shop drawings shall be submitted in accordance with the General Conditions and shall consist of a complete list of equipment and materials, including manufacturer's descriptive and technical literature, control sequences, catalog cuts, and installation instructions. Shop drawings shall also contain complete wiring and wiring routing, routing, schematic diagrams, tag number of devices, software descriptions, calculations, and any other details required to demonstrate that the system has been and will function properly. Drawings shall show proposed layout and installation of all equipment and the relationship to other parts of the work.
- B. Shop drawings shall be approved before any equipment is installed. Therefore, shop drawings must be submitted in time for review so that all installations can be completed per the project's completion schedule.
- C. All drawings shall be reviewed after the final system checkout and updated or corrected to provide Record Drawings to show exact installation. Furnish three (3) sets of Record Drawings.

2.00 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. Provide electric control products in sizes and capacities indicated, consisting of dampers, thermostats, sensors and other components as required for complete installation. Except as otherwise indicated, provide manufacturer's standard control system components as indicated by published product information, designed and constructed as recommended by manufacturer as indicated.

2.02 CONTROL DAMPERS

- A. Low-Leakage Type (Outside Air, Exhaust/Relief Air Applications): Damper frame shall be not less than 16 gage galvanized steel structural hat channel with tabbed corners for reinforcement. Blades shall be single skin, not less than 16 gage galvanized steel with longitudinal grooves for reinforcement. Blade edge seals shall be PVC coated polyester fabric mechanically locked in the blade edge. Jamb seals shall be flexible metal, compression type, to prevent leakage between blade end and damper frame. Bearings shall be corrosion resistant, molded synthetic sleeve type turning in an extruded hole in the damper frame. Axles shall be square or hexagonal positively locked into the damper blade. Linkage shall be concealed out of the airstream within the damper frame to reduce pressure drop and noise. Control dampers shall be performance tested in accordance with AMCA Publication 500 with leakage not greater than 10 CFM per square foot at 4 in. w.g. when damper is being held by torque of 50 inch-pounds.
- B. Standard Type (Return Air Applications): Damper frame shall be not less than 16 gage galvanized steel structural hat channel with tabbed corners for reinforcement. Blades shall be single skin, not less than 16 gage galvanized steel with longitudinal grooves for reinforcement. Blade edge seals shall be PVC coated polyester fabric mechanically locked in the blade edge. Jamb seals shall be flexible metal, compression type, to prevent leakage between blade end and damper frame. Bearings shall be corrosion resistant, molded synthetic sleeve type turning in an extruded hole in the damper frame. Axles shall be square or hexagonal positively locked into the damper blade. Linkage shall be concealed out of the airstream within the damper frame to reduce pressure drop and noise. Control dampers shall be performance tested in accordance with AMCA Publication 500 with leakage not greater than 10 CFM per square foot at 4 in. w.g. when damper is being held by torque of 50 inch-pounds.

2.03 CONTROL DAMPER ACTUATORS

- A. Provide electric actuators of sufficient size and reserve power to operate control dampers matched to application as described in the Sequence of Operation. Upon loss of power, actuators shall operate in a fail-safe manner as indicated to be normally open or normally closed, or as required for freeze protection utilizing spring return or capacitors. Actuators shall be designed and listed to operate in the application environment.

2.04 ROOM THERMOSTAT

- A. Programmable type with seven day programming for two occupied and two unoccupied periods per day; individual occupied and unoccupied set points; three hour override of unoccupied program with automatic return to programmed schedule; battery back-up with rechargeable nicad battery; fan "auto" cycle available for both occupied and unoccupied cycles; automatic changeover on heating/cooling sequences. Thermostat shall be Honeywell T7300 with appropriate Q7300 switching sub-base, or most current equivalent model.

3.00 EXECUTION

3.01 ELECTRICAL

- A. Install systems and materials in accordance with manufacturer's instructions and roughing-in drawings, and details on drawings. Install electrical components and use electrical products complying with requirements of applicable Division 26 sections of these specifications. All system controllers, junction boxes, etc. shall be mounted at readily accessible and convenient locations and heights.
- B. Room Temperature Sensors and Thermostats - Mounting Heights:
- C. Room temperature sensors and thermostats with occupant adjustment capabilities shall be mounted with the highest operable part at 54 inches above finished floors where the clear floor space allows parallel approach by a person in a wheelchair.
- D. Room temperature sensors and thermostats with occupant adjustment capabilities shall be mounted with the highest operable part at 48 inches above finished floors where the clear floor space allows only forward approach by a person in a wheelchair.
- E. Room temperature sensors and thermostats without occupant adjustment capabilities shall be mounted at 60 inches above finished floors, unless otherwise specifically indicated on the Drawings.
- F. Control Wiring: The term "control wiring" is defined to include providing of wire, conduit and miscellaneous materials as required for mounting and connecting electrical control devices.
- G. Wiring System: Install complete control wiring system for electric control systems. Conceal wiring, except in mechanical rooms and areas where other conduit and piping are exposed. Provide multi-conductor instrument harness (bundle) in place of single conductors where number of conductors can be run along common path. Fasten flexible conductor's bridging cabinets and doors, neatly along hinge side, and protect against abrasion. Tie and support conductors neatly.

3.02 ADJUSTMENTS

- A. After completion of installation, adjust thermostats, dampers, motors and similar equipment provided as work of this section.

4.00 MEASUREMENT AND PAYMENT

4.01 GENERAL

- A. See Section 01 22 00 – Measurement and Payment for General Requirements. See Section 01 01 00 – Special Requirements/Bid Items for possible modifications to Standard Bid Items.
- B. If no specific bid item is provided, measurement and payment shall be considered incidental and shall be included in the bid price for other items of work for the project.

**** END OF SECTION ****

1.00 GENERAL

1.01 DESCRIPTION OF WORK:

- A. Work consists of furnishing all labor, materials, and equipment for the supply and installation of Exhaust Fans. See also other heating and ventilation specifications.
- B. Special provisions, requirements and/or revisions to this Specification and/or Bid Item(s) may be included in Section 01 01 00 (green pages) and/or on the Drawings or Details.
- C. Related Sections:
 - 1. Section 15 00 00 – General Mechanical Provisions
 - 2. Section 23 09 00 – Automatic Temperature Control

1.02 SUBMITTALS:

- A. Shop drawings and product data sheet submittals shall conform to Section 01 33 00 of the Specifications.
- B. Indicate on shop drawings, assembly, unit dimensions, weight loading, required clearances, construction details, and field connection details.
- C. Provide product data indicating dimensions, weights, capacities, ratings, fan performance, motor electrical characteristics, gages and finishes of materials.
- D. Provide fan curves with specified operating point clearly plotted.
- E. Submit sound power levels for both fan outlet and casing radiation at rated capacity.
- F. Submit electrical requirements for power supply wiring including wire diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring.

1.03 QUALITY ASSURANCE:

- A. **Manufacturer's Qualifications:** Provide units that are the standard product of an equipment manufacturer regularly engaged in the production of such unit who issues complete catalog information on such products.
- B. Fans used shall not decrease motor size, increase noise level, increase tip speed by more than 10 percent or increase inlet air velocity by more than 20 percent, from specified criteria; and capable of accommodating static pressure variations of plus or minus 10 percent.

1.04 DELIVERY, STORAGE AND HANDLING:

- A. Deliver units to the site in containers with manufacturers stamp or label affixed.

- B. Store/protect units and piping against dirt, water, chemical and mechanical damage. Do not install damaged units – remove from project site.

1.05 ENVIRONMENTAL REQUIREMENTS:

- A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

1.06 WARRANTY:

- A. Provide general one-year (12 months) warranty from Project Substantial Completion. The warranty shall include parts, labor, travel costs and living expenses incurred by the manufacturer to provide factory authorized service.

2.00 PRODUCTS

2.01 EXHAUST FANS:

- A. General: All units shall be of heavy-duty aluminum construction with weatherproof motor covers, backward inclined wheels, Integral vibration isolators and all necessary accessories. All fans shall be rated for continuous 24 hours per day service. All fans shall be complete with motors, flexible connections to supply and/or suction ducts. All fans shall be belt-driven complete with adjustable motor bases and belt guards. All exposed fan propellers located 8 feet or less above working floor elevation, or otherwise easily accessible, shall be provided with a finger proof wire guard. All fan wheels shall be statically and dynamically balanced and shall be free from objectionable vibration or noise. Fans shall be provided in types and capacities as indicated on Contract Drawings. All fans shall be supplied with motor starters and controls as shown on the Contract Drawings and/or specified in Division 26 herein.
- B. Roof Mounted Fans: Roof exhaust fans shall be provided with gravity back draft dampers and 12" high factory roof curbs. Fans shall be belt drive. Fans shall include backward inclined wheels, integral vibration isolators and counter flashing curb bases. Fans shall be all aluminum.
- C. Wall Mounted Fans: Wall-mounted exhaust fans shall be belt driven and shall be supported on metal frames for mounting, with adjustable motor bases and OSHA approved safety guards. Fan weather hoods shall be provided and special provisions shall be provided for draining rainwater away from walls to prevent stains or water streaks on hoods. Wall mounted fans shall be Loren Cook ACWB, or equal.

2.02 ROOF CURBS:

- A. Where roof curbs are not provided by other sections of the Specifications, provide prefabricated insulated roof curbs as required for equipment or ductwork as shown on plans.
- B. Standard curbs, unless otherwise noted, shall be constructed as follows:
 - 1. Construct of heavy gauge galvanized steel with continuous welds on shell seams.

2. Insulation to be 1-1/2" thick, 3 pound density rigid fiberglass.
 3. Curb to have a raised 4", 45 degree cant.
 4. Curb to have 1-1/2" x 1-1/2" wood nailer.
 5. Curb height to be 12" above roof deck.
 6. Cant shall be raised to match roof insulation thickness.
- C. Curb to be constructed to meet equipment size and weight requirements. Curbs shall be provided by same manufacturer as manufacturer of equipment requiring support, wherever available. Provide tapered curbs to match roof pitch where required.

3.00 EXECUTION

3.01 INSTALLATION:

- A. Install in accordance with manufacturer's instructions.
- B. Examine site to verify if site is ready to receive work. Provide a layout of furnaces and fan locations to the electrical installer.
- C. Install flexible connections between fan inlet and discharge ductwork. Ensure metal bands of connectors are parallel with minimum 1inch flex between ductwork and fan while running.

4.00 MEASUREMENT AND PAYMENT

4.01 GENERAL:

- A. See Section 01 22 00 - Measurement and Payment for General Requirements. See Section 01 01 00-Special Requirements/Bid Items for possible modifications to Standard Bid Items.
- B. If no specific bid item is provided, measurement and payment shall be considered incidental and shall be included in the bid price for other items of work for the project.

****END OF SECTION****

1.00 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following:

- 1. Axial wall ventilators.
- 2. Ceiling-mounted ventilators.

1.03 PERFORMANCE REQUIREMENTS

- A. Project Altitude: Base air ratings on actual site elevations.
- B. Operating Limits: Classify according to AMCA 99.

1.04 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:

- 1. Certified fan performance curves with system operating conditions indicated.
- 2. Certified fan sound-power ratings.
- 3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
- 4. Material gages and finishes, including color charts.
- 5. Dampers, including housings, linkages, and operators.

- B. Maintenance Data: For power ventilators to include in operation and maintenance manuals.

1.05 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.
- C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.
- D. UL Standards: Power ventilators shall comply with UL 705; UL 762 for grease-laden air applications.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fans as factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering.
- B. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.
- C. Lift and support units with manufacturer's designated lifting or supporting points.

1.07 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Belts: One set for each belt-driven unit

2.00 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Acme Engineering & Mfg. Corp.
 - 2. Carnes Company HVAC.
 - 3. Loren Cook Company.
 - 4. Greenheck.

2.02 CENTRIFUGAL WALL VENTILATORS

- A. Description: Belt-driven or direct-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and accessories.
- B. Housing: Heavy-gage, removable, spun-aluminum, dome top and outlet baffle; venturi inlet cone.
- C. Fan Wheel: Aluminum hub and wheel with backward-inclined blades.
- D. Belt-Driven Drive Assembly: Resiliently mounted to housing, with the following features:
 - 1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
 - 2. Shaft Bearings: Pre-lubricated and sealed, self-aligning, pillow-block-type ball bearings.
 - a. Ball-Bearing Rating Life: ABMA 9, L_{10} of 40,000 hours.
 - 3. Pulleys: Cast-iron, adjustable-pitch motor pulley.
 - 4. Fan and motor isolated from exhaust airstream.

E. Accessories:

1. Variable-Speed Controller: Factory-installed or field-installed for direct-driven motors where scheduled. Solid-state control to reduce speed from 100 percent to less than 50 percent.
2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through internal aluminum conduit.
3. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
4. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in wall sleeve; factory set to close when fan stops.

2.03 CEILING-MOUNTED VENTILATORS

- A. Description: Centrifugal fans designed for installing in ceiling or wall or for concealed in-line applications.
- B. Housing: Steel, lined with acoustical insulation.
- C. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.
- D. Grille: Powder-coated steel or stainless-steel louvered grille with flange on intake and thumbscrew attachment to fan housing.
- E. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.
- F. Accessories:
 1. Variable-Speed Controller: Factory-installed or field-installed for direct-driven motors where scheduled. Solid-state control to reduce speed from 100 percent to less than 50 percent.

2.04 SOURCE QUALITY CONTROL

- A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

3.00 EXECUTION

3.01 INSTALLATION

- A. Install power ventilators level and plumb.
- B. Ceiling Units: Suspend units from structure; use steel wire or metal straps as needed, and in accordance with manufacturers recommendations for this specific installation.
- C. Install units with clearances for service and maintenance.
- D. Label units according with the specifications and Owner requirements.

3.02 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories.
- B. Install ducts adjacent to power ventilators to allow service and maintenance.
- C. Ground equipment.
- D. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.03 FIELD QUALITY CONTROL

- A. Equipment Startup Checks:
 - 1. Verify that shipping, blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 3. Verify that cleaning and adjusting are complete.
 - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 - 5. Verify lubrication for bearings and other moving parts.
 - 6. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
 - 7. Shut unit down and reconnect automatic temperature-control operators.
 - 8. Remove and replace malfunctioning units and retest as specified above

- B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.04 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension.

4.00 MEASUREMENT AND PAYMENT

4.01 GENERAL

- A. See Section 01 22 00 - Measurement and Payment for General Requirements. See Section 01 01 00-Special Requirements/Bid Items for possible modifications to Standard Bid Items.
- B. If not specific bid item is provided, measurement and payment shall be considered incidental and shall be included in the bid price for other items of work for the project.

**** END OF SECTION ****



1130 W. Hayden Ave., Suite 101
Hayden, ID 83835
208|676-8001 208|676-0100 Fax

SPECIFICATION STAMP PAGE

DATE: November 18, 2019

CLIENT: Varela & Associates, Inc.
601 W. Mallon Avenue
Suite A
Spokane, WA 99201

PROJECT: City of Leavenworth,
Washington Wastewater
Treatment Plant
Improvements 2019

PROJECT#: 18210

ENGINEER: L. Ryan Litzko, P.E.

<u>Section</u>	<u>Specification Description</u>
260126	Electrical Testing
260519	Wire and Cable
260526	Grounding
260533	Raceways
262200	Low Voltage Transformers
262416	Panelboards
262726	Wiring Devices
262800	Overcurrent Protective Devices
262816	Safety and Disconnect Switches
265000	Lighting
266000	Electrical General Provisions
266001	Electrical Scope of Work
266002	Basic Materials and Methods
267000	Motors
269010	Variable Frequency Drives
269017	Solid-State Starter Equipment
269020	Motor Control Centers

The technical specification sections listed above have been prepared under the direction of the Professional Engineer, registered in the State of Washington, whose seal and signature appear below:



11/18/19

Issued for Bid

1.00 GENERAL

1.01 SECTION INCLUDES:

A. Material and installation requirements for:

1. Testing of Electrical Systems

1.02 DESCRIPTION OF WORK:

A. Provide testing of electrical work installed under Division 26, as specified herein and in other Division 26 sections. Feeders and equipment shall not be placed in service until they have been checked and tested, as applicable.

B. RELATED SECTIONS:

C. Related Sections include but are not necessarily limited to:

1. Section 26 60 00 – Electrical General Provisions
2. Section 26 60 01 – Electrical Scope of Work
3. Section 26 60 02 – Basic Materials and Methods
4. Section 26 05 19 – Wire and Cable
5. Section 26 05 26 – Grounding
6. Section 26 70 00 – Motors
7. Section 26 90 21 – Control System
8. Section 26 90 22 – Pump Control Panel
9. Division 40 – Process Instrumentation

1.03 STANDARDS AND REFERENCES:

- A. All materials and equipment specified herein shall, within the scope of UL Examination Services, be approved by the Underwriter's Laboratories for the purpose for which they are used and shall bear the UL label.
- B. All materials and equipment specified herein shall conform with all applicable NEMA, ANSI and IEEE Standards
- C. All materials and equipment specified herein and their installation methods shall conform to the latest published version of the National Electrical Code, NEC.

1.04 SUBMITTALS:

A. Shop Drawings

1. See Section 26 60 00.

- B. Testing Procedures: Submit four copies of all proposed testing procedures to the Engineer for review at least 14 working days prior to conducting any testing on the project.
- C. Reporting Forms: Submit four copies of the proposed forms to be used in recording testing data and results to the Engineer for review at least 14 working days prior to conducting any testing on the project.
- D. Test Data and Results: Submit four copies of complete data and certified test results for each test performed, including, but not limited to:
 - 1. Manufacturers test forms,
 - 2. Test performed,
 - 3. Test procedure,
 - 4. System and area tested,
 - 5. Date(s) and time(s) of test,
 - 6. Weather conditions,
 - 7. Test criteria,
 - 8. Test results,
 - 9. Additional information pertinent to the specific type of testing.
- E. Operational Certification: Submit four certified copies of an operational certification which documents that all equipment and systems have been fully tested to verify proper operation in accordance with the design shown in the Contract documents and manufacturer's recommendations.
- F. Certification: Certifications stating that submitted test data and results are true and correct shall be provided for all submittals under this section. Certification shall be executed by an authorized officer if the Contractor is a corporation, by a partner if the Contractor is a partnership, by the owner if the Contractor is a sole proprietorship or by the authorized representative if the Contractor is a joint venture.
- G. Calibration List: Submit four copies of a listing of testing devices to be used for the project to the Engineer for approval. Listing shall include documentation that the devices are properly calibrated.
- H. Test Log: The Contractor shall maintain a test log at the site to document the results of all successful and unsuccessful testing as it is performed. This log shall be available for review by the Engineer and a copy of the log shall be submitted to the Engineer prior to the Substantial Completion inspection. A space shall be provided on the test log signoff by the Engineer or Owners representative.
- I. Notice:
 - 1. Notify the Engineer in writing 14 working days prior to all scheduled testing to allow time for Engineer to schedule witnessing of testing, where elected by Engineer.

2.00 PRODUCTS

2.01 TESTING MATERIALS:

- A. General: Provide all materials and test equipment required for testing of specified electrical systems, including re-testing until acceptable results are obtained.
- B. Products: Tested products which fail to provide acceptable test results shall be repaired or replaced with suitable materials as required to obtain acceptable results.

2.02 TESTING:

- A. General: Test shall be made during the course of the construction as specified and as required by authorities having jurisdiction. Such test shall be conducted by this Division as part of the Work and shall include all personnel, material, and equipment required to perform test until satisfactory results are obtained. Any defects detected during testing shall be satisfactorily repaired or the equipment involved shall be replaced and the test re-executed.
- B. Prior to testing, engineer shall be given at least (1) weeks' notice for the opportunity to observe testing.
- B. Testing shall include but not be limited to all items in other Sections of this Division and the following:
 - 1. Feeders: Refer to Section 26 05 19.
 - 2. Ground System: Refer to Section 26 05 26.
 - 3. Motors: Refer to Section 26 70 00.
 - 4. Control System: Refer to Section 26 90 21.
 - 5. Heat Tracing: Test per manufacture's instructions. Provide submittal showing manufactures test requirements and test results via submittal. All testing shall be done prior to and after installation.
 - 6. Instrumentation: Attached testing sheets and specification 26 80 00.
- C. Test Reports (Attached)
 - 1. ELECTRICAL SYSTEM TEST REPORT - 600V CABLE
 - 2. ELECTRICAL GROUND ROD TEST REPORT
 - 3. MOTOR TEST REPORT
 - 4. TRANSMITTER CALIBRATION / TEST DATA FORM
 - 5. INDICATOR / RECORDER CALIBRATION TEST DATA FORM

3.00 EXECUTION

3.01 NONE.

26 01 26 ELECTRICAL SYSTEM TEST REPORT - 600V CABLE

ELECTRICAL SYSTEM
DESCRIPTION DATA

SERVICE DESCRIPTION:

nominal voltage, phase to phase
phase to neutral - single or three phase-
number of conductors

SERVICE CONDUCTORS:

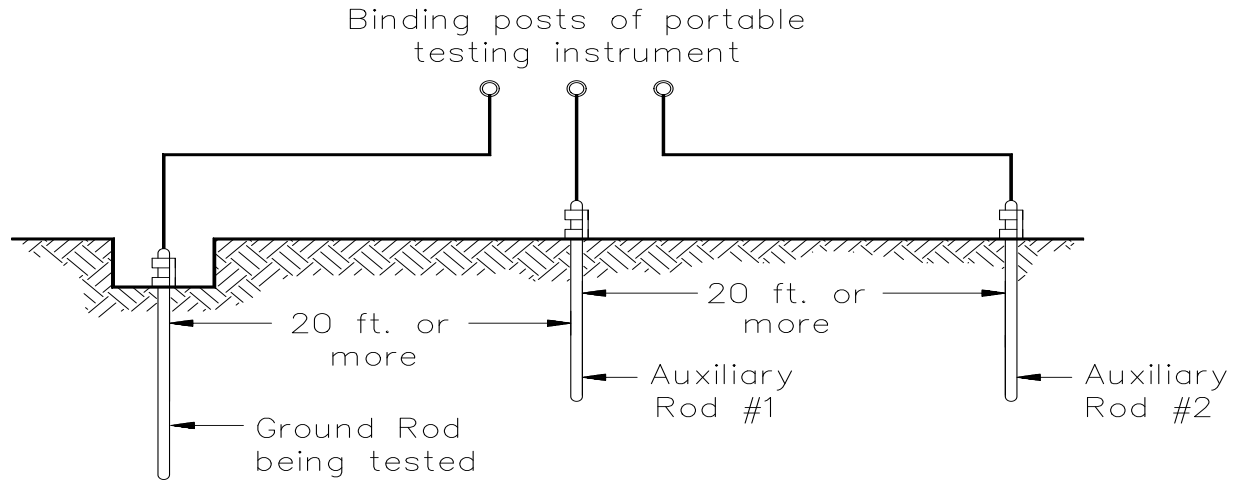
phase size and insulation type
neutral size and insulation type
ground size and insulation type

SERVICE DISCONNECT DESCRIPTION:

circuit breaker or disconnect switch
size (amps)
fuse (amps)

MEASURED CONDITIONS		DATA		
Operating Load Voltage	Volts	Vab_____	Vbc_____	Vca_____
		Van_____	Vbn_____	Vcn_____
Operating Load Feeder Current	Amps	Ia_____	Ib_____	Ic_____
Conductor Insulation Resistance (record the indicated measurement for each of the following circuits:)	Megohms	a-b_____	b-c_____	c-a_____
	Megohms	a-g_____	b-g_____	c-g_____
1. Service Feeders				
2. Panel Feeders				
3. Process Equipment Feeders				
4. 480 V Power distribution circuits including transformer secondaries.				
5. Motor Feeders				
6. Heat Tracing (prior to and following installation)				

26 01 26 - ELECTRICAL GROUND ROD TEST REPORT



GROUND ROD RESISTANCE TESTING

PROCEDURE:

PRIOR TO ANY EQUIPMENT ENERGIZATION AND FOLLOWING COMPLETE GROUND SYSTEM INSTALLATION:

1. Schedule testing date with Engineer
2. Perform testing below

To measure ground resistance, two additional temporary grounds, consisting of short rods 2 or 3 feet long, shall be driven in the ground at least 20 feet away from the rod being tested. A direct-reading ground resistance tester shall then be connected to the three ground rods by means of insulated leads. The battery operated ground resistance tester reads the resistance of the ground rod being tested directly in ohms. The ground rod location / designation and its measured ohm value shall be recorded in chart below.

GROUND ROD LOCATION / DESIGNATION	OHM VALUE
1. Ground Rod #3	*
2. Ground Rod #2	*
3. Composite Ground	*

*Ohm value of a single ground rod shall not exceed 25 Ohms. If additional ground rod(s) are added, the "composite" ground electrode shall have a maximum acceptable reading of 15 Ohms which shall be recorded in chart above.

26 01 26 - MOTOR DATA AND TEST REPORT

EQUIPMENT NAME AND NUMBER: _____

EQUIPMENT SPECIFICATION SECTION: _____

MOTOR STARTER LOCATION _____

CONTRACTORS REPRESENTATIVE _____ DATE _____

MOTOR NAMEPLATE DATA

MFR Name/Model No. _____
Voltage/Phase/HP _____
FLA/LRA _____
Service Factor _____
Efficiency Index (or percent) _____
NEMA Design _____
Code Letter _____
Insulation Type _____
Temperature Rise _____
Ambient Temperature _____
RPM _____
Enclosure _____
Thermal Trip Setting _____
Space HTR: Watts/Volts _____
Other Data _____

MOTOR STARTER INFORMATION

Manufacturer/Type _____
Overload Heater No _____

* <u>RECORDED FULL LOAD DATA</u>	VOLTS	A-G	_____	B-G	_____	C-G	_____
FULL LOAD OPERATING VOLTAGE	VOLTS	A-B	_____	B-C	_____	C-A	_____
FULL LOAD OPERATING CURRENT	AMPS	A	_____	B	_____	C	_____

INSULATION RESISTANCE	MEGOHMS	A-G	_____	B-G	_____	C-G	_____
(deenergized)							

MOTOR CIRCUIT RESISTANCE	OHMS	A-B	_____	B-C	_____	C-A	_____
--------------------------	------	-----	-------	-----	-------	-----	-------

***VOLTAGE & CURRENT READINGS SHALL BE TAKEN AT THE CLOSEST ACCESSIBLE POINT TO THE LOAD**

26 01 26 - TRANSMITTER CALIBRATION / TEST DATA FORM

Tag. No. and/or Description: _____ Serial No. _____

Make and Model No.: _____

Associated Panel: _____

Type of testing equipment used: _____

Input: _____

Output: _____

Range: _____ Scale: _____

Calibrated Value (flow/pressure/turbidity etc.) at 4mA _____

Calibrated Value (flow/pressure/turbidity etc.) at 20mA _____

Simulate process variable (flow, pressure, turbidity, etc.) and measure output with appropriate meter. Related value is (example: the level associated with the pressure).

<u>% Range</u>	<u>Input (engr. units)</u>	<u>Related value</u>	<u>Expected Output</u>	<u>Actual Output</u>
0	_____	_____	_____	_____
25	_____	_____	_____	_____
50	_____	_____	_____	_____
75	_____	_____	_____	_____
100	_____	_____	_____	_____

COMMENTS:

TESTED BY _____ DATE: _____

OWNERS REPRESENTATIVE _____ DATE: _____

26 01 26 - INDICATOR / RECORDER CALIBRATION TEST DATA FORM

Tag. No. and/or Description: _____ Serial No. _____

Make and Model No.: _____

Associated Panel: _____

Input: _____

Output: _____

Range: _____ Scale: _____

Calibrated Value (flow/pressure/turbidity etc.) at 4mA _____

Calibrated Value (flow/pressure/turbidity etc.) at 20mA _____

Simulate process variable (flow, pressure, turbidity, etc.) and measure output with appropriate meter. Related value is (example: the level associated with the pressure).

<u>% Range</u>	<u>Input (engr. units)</u>	<u>Related value</u>	<u>Expected Output</u>	<u>Actual Output</u>
0	_____	_____	_____	_____
25	_____	_____	_____	_____
50	_____	_____	_____	_____
75	_____	_____	_____	_____
100	_____	_____	_____	_____

For level indicators, enter elevation of 4mA here _____

COMMENTS:

TESTED BY _____ DATE: _____

OWNERS REPRESENTATIVE _____ DATE: _____

****END OF SECTION****

1.00 GENERAL

1.01 SECTION INCLUDES:

A. Material and installation requirements for:

1. Building wire
2. Power and control cable
3. Instrumentation cable
4. Wire connectors
5. Insulating tape
6. Pulling lubricant

1.02 DESCRIPTION OF WORK:

- A.** This section covers furnishing and installation of all wiring and connections used in the construction of this facility.
- B.** All wiring shall be in raceways.

1.03 RELATED SECTIONS:

A. Related Sections include but are not necessarily limited to:

1. Section 26 60 00 – Electrical General Provisions
2. Section 26 60 02 – Basic Materials and Methods
3. Section 26 01 26 – Electrical Testing
4. Section 26 05 33 – Raceways
5. Section 26 05 26 – Grounding
6. Section 26 70 00 – Motor
7. Section 26 90 10 – Variable Frequency Drives
8. Section 26 90 21 – Control System
9. Section 26 90 22 – Pump Control Panel

1.04 STANDARDS AND REFERENCES:

- A.** All materials and equipment specified herein shall, within the scope of UL Examination Services, be approved by the Underwriter's Laboratories for the purpose for which they are used and shall bear the UL label.
- B.** Products shall be designed, manufactured, tested, and installed in compliance with the following standards:
1. Insulated Cable Engineers Association:

- a. S-58-679, Control Cable Conductor Identification

- 2. Institute of Electrical and Electronic Engineers (IEEE):
 - a. 518, Guide for the Installation of Electrical Equipment to Minimize Electrical Noise Inputs to Controllers from External Sources

- 3. National Electrical Manufacturers Association (NEMA):
 - a. ICS 4, Terminal Blocks for Industrial Use

- 4. National Electrical Manufacturers Association/Insulated Cable Engineers Association (NEMA/ICEA):
 - a. WC 70/ICEA S-95-658, Standard for Nonshielded Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy

- 5. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC)
 - b. 262, Method of Test for Fire and Smoke Characteristics of Wires and Cables.

- 6. Underwriters Laboratories, Inc. (UL):
 - a. 13, Power-Limited Circuit Cables
 - b. 44, Thermoset-Insulated Wires and Cables
 - c. 83, Thermoplastic-Insulated Wires and Cables
 - d. 467, Grounding and Bonding Equipment
 - e. 486A, Wire Connectors and Soldering Lugs for use with Copper Conductors
 - f. 486C, Splicing Wire Connectors
 - g. 510, Insulating Tape
 - h. 1581, Reference Standard for Electrical Wires, Cables, and Flexible Cords

- C. All materials and equipment specified herein and their installation methods shall conform to the latest published version of the National Electrical Code, NEC.

1.05 DEFINITIONS:

- A. Cable: Multi-conductor, insulated, with outer sheath containing either building wire or instrumentation wire.

- B. Instrumentation Cable: Multiple conductor, insulated, twisted or untwisted, with outer sheath. The following are specific types of instrumentation cables:
 - 1. Analog signal cable: Used for the transmission of low current (e.g., 4-20mA DC) or low voltage (e.g., 0-10 V DC) signals, using No. 16 AWG and smaller conductors. Commonly used types are defined in the following:

- a. UTP: Unshielded twisted pair,
 - b. TSP: Twisted shielded pair, (or STP: Shielded twisted pair),
 - c. TST: Twisted shielded triad.
2. Digital signal cable: Used for the transmission of digital signals between computers, PLC's, RTU's, etc.
- C. Power Cable: Multi-conductor, insulated, with outer sheath containing building wire, AWG No. 8 and larger.
- D. Control Cable: Multi-conductor, insulated, with outer sheath containing building wires, AWG No. 16, AWG No. 14, AWG No. 12 or AWG No. 10.
- E. Building Wire: Single conductor, insulated, with or without outer jacket depending upon type.

1.06 SUBMITTALS:

A. Shop Drawings

- 1. See Section 26 60 00.

2.00 PRODUCTS

2.01 CONDUCTORS:

- A. Conductors shall be stranded copper. Sizes AWG No. 14, 12 and 10 for general purpose lighting and receptacle wiring and all wiring within circuit breaker panels may be solid. All other conductors shall be stranded. Insulation shall be THW-2, THWN-2, or THHN, (90°F) chosen to satisfy environmental conditions. Conductors used for power circuits shall not be smaller than AWG No. 12. Control conductors may be AWG No. 14.

2.02 CONNECTORS:

- A. Ideal Industries "Wing Nut" or 3M Company "SCOTCHLOCK" pre-insulated connectors may be used for lighting and receptacle circuits for splices and taps in conductors AWG No. 10 and smaller. For AWG No. 8 and larger conductors, utilize Thomas & Betts compression connectors. Compress using recommended die and tools.
- B. For connections of wire to cord to removable equipment provided with integral cords (such as floats, transmitters, limit switches, aerators, submersible pump motors, etc.) provide junction box with terminals and spade/lug type terminations and coat with liquid insulation.
- C. For connections of wire to cord for submersible motors of all size wire use a water proof motor stub insulator: Thomas & Betts multi splice insulator MSLT112-4 or equal.

2.03 SPLICE INSULATION:

- A. Splice insulation shall be equal to the conductor utilized.
- B. Insulate all permanent splices that are underground or in damp or corrosive environments with cast epoxy type insulation which covers the jacket of all cords and the insulation on all wire. Epoxy splice shall be Scotch #3570 or equal.

2.04 SHIELDED SIGNAL CABLE:

- A. Signal conductor cable shall be AWG No. 16 individually twisted, shielded pairs, BELDEN #8719, or equal. Conductors shall be tinned copper with color coded 90° C PVC insulation and individual conductor jacket of nylon. Shielding shall be aluminum polyester 100% shield coverage with drain wire. The cable shall have an overall PVC jacket. The insulation system shall be rated for 300V.
- B. For applications where 600V insulation is required, 600V insulated signal wire shall only be used where required by Code. BELDEN 1120A or equal.

2.05 DATA COMMUNICATIONS CABLE (UTP):

- A. Data communications cable shall be four pair unshielded twisted pair, AWG No. 24 copper. Cable shall be enhanced EIA/TIA category 5 cable.
- B. Cable shall be used for short haul applications of 100 meters or less between devices, unless approved by Engineer.
- C. Acceptable Manufacturers:

	APPLICATION	
Manufacturer:	Non-Plenum:	Plenum:
Commspec	#5504	#44N4
Belden “Data Twist”	#350	-
AT & T	#2061	#1061

2.06 TELEPHONE COMMUNICATIONS CABLE:

- A. Telephone communications cable shall be AWG No. 24, solid tinned copper conductors, PVC insulated with chrome PVC jacket. Conductors shall be rated for 150V, 80° C. Provide 4 pair minimum to individual phone outlet locations. Provide 6 pair service cable, or as indicated in the telephone riser diagram or on the drawings. Cable to be as manufactured by BELDEN or approved equal.

2.07 FIBER OPTIC CABLE:

- A. Fiber optic cable shall be Multimode 62.5/125 and shall adhere to the FDDI Grade F Specification for performance.
- B. Fiber optic cable shall be suitable for application in conduit runs within buildings.
- C. Fiber optic cable shall be suitable for applications between buildings in outdoor/buried conduit runs.
- D. The Contractor shall use jumper cables between patch/breakout panels and communications equipment.
- E. Fiber optic cables shall have a minimum of 2 fibers plus 2 spare fibers for every utilized communication transmit/receive pair (or as shown on the drawings).

- F. Provide all necessary accessory equipment for a complete installation as recommended by the Manufacturer for a complete installation.

2.08 MOTOR TERMINAL SPLICE INSULATION:

- A. Provide motor terminal splice insulation in the motor connection box that will withstand constant vibration and abrasion without degrading the insulation of the splice. A product shall be used that is specifically designed for the purpose of motor terminations.
- B. For motor splices in general purpose areas use a bolted splice with a TY-RAP boot type insulator, Thomas & Betts splice insulator series MSC. For splices using wire larger than AWG No. 8 it is also acceptable to use a heat shrinkable motor connection stub splices, RAYCHEM, MCK-V series or equal.
- C. For motors in outdoor, damp, or corrosive environments, use a water proof motor stub insulator, Thomas & Betts multi splice insulator MSLT112-4 or equal. For splices using wire larger than AWG No. 8 it is also acceptable to use a heat shrinkable motor connection stub splices, RAYCHEM, MCK-V series or equal.

3.00 EXECUTION

3.01 GENERAL:

- A. Splicing of power and control and signal wires or cables is not allowed. All wire transitions shall be done on terminals.
- B. Keep all conductors within the allowable tension limits during installation. Lubricants for wire pulling, if used, shall be approved for the insulation and raceway material. Observe cable manufacturer's and industry standard cable bending radius recommendations.
- C. Incoming cables in panels and motor control centers, AWG No. 6 and smaller, shall be bundled and laced at intervals not greater than 6 inches and neatly spread into trees and connected to their respective terminals.
- D. Sufficient slack shall be allowed in cables for alterations in terminal connections. Lacing shall be done with plastic cable ties using a tensioning tool designed for that purpose.
- E. Cables crossing hinges shall be made up into groups not exceeding 12 and shall be so arranged that they will be protected from chafing when the hinged member is moved.
- F. Cables installed in handholes shall be bundled and neatly racked to the side of the handhole. All splices (if allowed) shall be a minimum of 6 inches above the bottom of the handhole.

3.02 WIRE AND CABLE TERMINATION:

- A. Power conductors, AWG No. 8 and larger may be terminated directly in box-type lugs.
- B. Solid conductors (when allowed for lighting and receptacle circuits) of AWG No. 10 and AWG No. 12 may be directly terminated to screw terminals.
- C. For any power, control, or signal wire terminating on screw type terminals; provide spade or ring tongue type terminations.

- D. Stranded control conductors may be directly terminated in box type terminals at control panels. Insulated terminals shall be used also on all stranded instrumentation wiring.
 - E. Special instrumentation cables shall be terminated in accordance with the recommendations of the manufacturer of the equipment and subject to review by the Engineer.
 - F. No splices shall be used in power, control and/or signal wiring. The wiring shall be continuous from point-to-point.
 - G. Extending existing cables will not be allowed except where shown on the drawings.
 - H. Existing wiring must be removed and replaced with new.
 - I. Terminals and connectors shall be installed with the compression tool recommended by the terminal manufacturer. Solid wire shall not be lugged, but shall be terminated with a full ring eye of the wire under the binding-head screw or saddle of the terminal block. Electrical spring connectors may be used only on lighting circuits.
- 3.03 COLOR CODING:
- A. Wiring shall conform to the following color code.
 - B. Insulation on phase conductor sizes AWG No. 10 and smaller shall be colored, No.8 AWG and larger may have black insulation with plastic tape of the appropriate color from the table below.
 - C. Insulation on the grounded conductor (neutral) sizes AWG No. 8 and smaller shall be colored, AWG No. 6 and larger may have black insulation with plastic tape of white or gray in accordance with the table below.

Description	120/208V	277/480V	Control
Phase A (Left)	Black	Brown	--
Phase B (Center)	Red	Orange	--
Phase C (Right)	Blue	Yellow	--
Neutral	White	Gray	White
Ground	Green	Green	Green
120 VAC Control	--	--	Red
120 VAC Control	Neutral	--	White
DC Control (+)	--	--	Blue
DC Control (-)	--	--	Gray
External Source	--	--	Yellow

- D. All control wiring in control panels or other enclosures that is powered from an external source and is not disconnected by the control panel disconnect shall be terminated at a disconnecting terminal block upon entering the enclosure. The color of the wire shall then be changed to yellow to identify it as being powered from an external source. Provide identification nameplate on exterior of enclosure to indicate sources of external power.
- E. All wiring in industrial machines and equipment shall be in accordance with NFPA 79. Notify Owner of any deficiencies noted during installation.

3.04 TERMINAL MARKING:

- A. All terminals in instrument and relay compartments, motor control centers, control panels, instrument panels, field panels and control stations, as well as connections to mechanical equipment, shall have reference number and letter in accordance to the following:
1. h = Control power hot (usually 120V or 24V)
 2. n = neutral
 3. g = ground
 4. x = PLC input (number shall correspond to the program input number)
 5. y = PLC output (number shall correspond to the program output number)
 6. ax = PLC signal/analog input (number shall correspond to the program input number)

7. ay = PLC signal/analog output (number shall correspond to the program output number)
8. c = control (use if none of the above letters apply)
9. p = power (usually 480V)
10. s = signal (usually 4-20ma or 1-5V) (use if none of the above letters apply)
11. B = DC (+) and (-)

3.05 CONDUCTOR SPACING:

A. Unless specifically shown otherwise on the drawings, in all areas maintain a minimum 2-inch separation between all conductors of different voltages. For parallel runs over 6 feet maintain the following minimum separation between conductors:

1. Signal (12/24) VDC and 120 VAC 6 inches
2. Signal (12/24) VDC and 480 VAC 12 inches
3. 120 VAC control wire and 480 VAC 2 inches

3.06 WIRE BENDING RADIUS:

A. The radius of bends in all wire (conductors and cables) shall not be less than five (5) times the outside diameter of the wire. Any wire installed with bends less than five times the diameter which the Engineer deems has caused that insulation to be damaged shall be removed and new wire shall be installed.

3.07 PULLING & TERMINATING FIBER OPTIC CABLE:

- A. Pulling and termination of fiber shall be performed by technicians who have been certified in the use of tools and material for making a fiber optic termination by AT&T or Sicom or equal.
- B. All terminations will be inspected via microscope by the Contractor to verify the polish, splice and connection is within specification.
- C. Continuity of the fiber shall be verified prior to installation in conduit.
- D. Bend Radius shall not be exceeded when pulling fiber.
- E. Following installation, test each installed fiber optic cable line, document testing and measured losses, and provide all testing results documentation to Engineer.

3.08 VISUAL AND MECHANICAL INSPECTIONS

- A. Inspect exposed section for physical damage.
- B. Verify that cable is supplied and connected in accordance with specifications and one-line diagram, and that phases are labeled correctly.

3.09 TESTING:

- A. See Section 26 01 26 – Electrical Testing.
- B. Insulation resistance testing for feeder conductors shall be performed, documented, and submitted via submittal for engineer review. Test voltage shall be a non-destructive test, applied DC voltage

shall be 500 VDC for 2 mins; test shall be performed for all configurations – L-L, L-N, L-G, etc.
Reference testing specification 26 01 26 for additional information.

****END OF SECTION****

1.00 GENERAL

1.01 SECTION INCLUDES:

A. Material and installation requirements for:

1. Grounding

1.02 DESCRIPTION OF WORK:

A. This section covers furnishing and installing all grounding and/or bonding conductors, connectors, ground rods and terminations as required to meet these specifications and to comply with Article 250 of the National Electric Code.

1.03 RELATED SECTIONS:

A. Related Sections include but are not necessarily limited to:

1. Section 26 60 00 – Electrical General Provisions
2. Section 26 60 02 – Basic Materials and Methods
3. Section 26 05 19 – Wire and Cable
4. Section 26 05 33 – Raceways
5. Section 26 22 00 – Low Voltage Transformers
6. Section 26 24 13 – Switchboards
7. Section 26 24 16 – Panelboards
8. Section 26 70 00 – Motors
9. Section 26 90 20 – Motor Control Centers
10. Section 26 90 21 – Control System
11. Section 26 90 22 – Pump Control Panel

1.04 STANDARDS AND REFERENCES:

A. All materials and equipment specified herein shall, within the scope of UL Examination Services, be approved by the Underwriter's Laboratories for the purpose for which they are used and shall bear the UL label.

B. Products shall be designed, manufactured, tested, and installed in compliance with the following standards:

1. American National Standards Institute:
 - a. ANSI/IEEE Standard 142 Recommended Practice for Grounding of Industrial and Commercial Power Systems.
2. American Society for Testing and Materials (ASTM):
 - a. B8, Standard Specification for Concentric Lay Stranded Copper Conductors, Hard, Medium Hard, or Soft.
3. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).

- 4. Underwriters Laboratories, Inc. (UL):
 - a. 467, Electrical Grounding and Bonding Equipment.

C. All materials and equipment specified herein and their installation methods shall conform to the latest published version of the National Electrical Code, NEC.

1.05 SUBMITTALS:

A. Shop Drawings

- 1. See Section 26 60 00.
 - a. A complete grounding system diagram for special grounding systems.
- 2. See Section 26 05 26.
 - a. After installation is complete:
 - i. Test reports
 - ii. Ground rod and grid test results

1.06 DELIVERY, STORAGE, AND HANDLING:

- A. See Section 26 60 00.

2.00 PRODUCTS

2.01 GENERAL

- A. For each electrical grounding connection, provide a complete assembly of materials to construct a completely grounded electrical system.
- B. Raceways for grounding conductors shall be as specified in Section 26 05 19.
- C. Grounding cable, wire and connectors shall be as specified in Section 26 05 33.
- D. Grounding conductors and jumpers shall be connected to each other and to items to be grounded by means of approved type pressure connectors, clamps, and other suitable methods approved by the Engineer. No solder connections shall be made.

2.02 GROUNDING ELECTRODE CONDUCTORS

- A. All concrete encased or direct buried underground grounding electrode conductors shall be soft drawn stranded bare copper cable, conforming to ASTM B8.
 - 1. Sized as required by Table 250 66 of the NEC, except where a larger size conductor is shown on the Contract Drawings.
 - 2. Minimum conductor allowed: 2/0.
- B. Equipment grounding conductor:
 - 1. Green copper conductor: Identical insulation to phase conductors.
 - 2. Sized as required by Table 250 122 of the NEC, except where a larger size conductor is shown on the Contract Drawings.

2.03 GROUND ROD BOXES:

- A. Provide ground rod boxes for each ground rod. Ground rod boxes shall be concrete with traffic rate covers, Fogtite SP-1, or approved equal.

2.04 **GROUNDING ELECTRODE RODS:**

- A. Grounding electrode rods used shall be a minimum of 3/4" diameter by 10' long, steel core and thick copper jacket (copperclad).
- B. Heavy uniform coating of electrolytic copper molecularly bonded to a rigid steel core. Corrosion resistant bond between the copper and steel. Hard drawn for a scar resistant surface. UL listed.
 - 1. Blackburn
 - 2. Thomas & Betts

2.05 **GROUND CLAMPS:**

- A. Ground clamps for connecting grounding conductors to copper, brass, or lead pipes shall be made of copper. If pipes are of steel or iron, the ground clamps should be made of galvanized iron. These clamps shall be designed to provide permanent and positive pressure and to avoid mechanical injury to the pipe. Use exothermic welds for connecting ground wires to ground rods for all below grade counterpoise grounds, grids, and elsewhere where noted on the Drawings.
- B. High copper alloy content, compression type, noncorrosive.
- C. UL 467 listed.
 - 1. Burndy
 - 2. ILSCO
 - 3. Thomas & Betts

2.06 **EXOTHERMIC WELD CONNECTIONS:**

- A. Use Cadweld or approved equal system of exothermic welding for welded grounding connections where shown on the Drawings or specified.
- B. Copper oxide reduction by aluminum process.
- C. Molds properly sized for each application.

3.00 **EXECUTION**

3.01 **INSTALLATION:**

- A. Install products in accordance with manufacturer's instructions.
- B. Remove paint, rust, or other nonconducting material from contact surfaces before making ground connections.
- C. Where ground conductors pass through floor slabs or building walls, sleeves of intermediate metal conduit of the required size, shape, and length shall be provided, unless otherwise specified or shown on Drawings.
- D. Ground Grid
 - 1. Locate ground rods at approximate locations shown on Drawings.
 - 2. Install rods in firm soil outside of excavated areas.

3. Place perimeter rods a minimum of 10 FT from the building foundation.
 4. Drive top of rod to minimum depth of 2 FT 6 IN below grade unless otherwise noted on Contract Drawings.
 5. Use driving studs or other suitable means to prevent damage to threaded ends of sectional rods.
 6. Interconnect all ground rods with grounding electrode conductor:
 7. Size per the NEC unless a larger size is shown on the Drawings.
 8. Do not splice grounding electrode conductor.
 9. Provide excavation required for installation of ground conductors buried in earth.
 10. Allow sufficient slack to prevent conductor breakage during backfill or due to ground movement.
 11. Leave taps, junctions, and splices uncovered until inspected by Engineer.
 12. Backfill around ground grid completely, thoroughly tamping to provide good contact between backfill materials and ground rods and conductors.
 13. Bond underground metal piping to the ground grid in accordance with NEC 250. Grounding clamps may be utilized on piping if exothermic welds may damage structural integrity.
 14. All underground connections shall be exothermically welded.
- E. Complete grid system:
1. Resistance of 15 ohms or less.
 2. Drive additional rods as required.
- 3.02 RACEWAY GROUNDING-CONDUIT
- A. All metallic conduit shall be electrically continuous.
- B. Provide grounding type insulating bushings:
1. For all equipment not supplied with a conduit hub.
 2. On ends of metallic conduit.
- C. Bond all conduit, at entrance and exit of equipment, to equipment ground bus or ground lug.
- D. Use manufactured conduit hubs at all panels.
- E. Provide bonding jumpers if conduit are installed in concentric knockouts.
- F. Make all metallic raceway fittings and grounding clamps tight to ensure equipment grounding system will operate continuously at ground potential to provide low impedance current path for proper operation of overcurrent devices during possible ground fault conditions.
- G. Provide bonding jumper from equipment ground lug to RGS conduit if flexible conduit is utilized for equipment connections.
- H. Provide bonding jumpers identical in conductor size to the largest ground conductor run within the conduit.
- 3.03 EQUIPMENT GROUNDING:

- A. Ground all voltage levels at the supply transformer from the secondary neutral to the ground grid. Provide two separate grounding conductors.
- B. Provide a grounding conductor between the supply transformer and the grounding buses of all supplied MCC's and/or switchgear.
- C. Ground all equipment supplied from an MCC or switchgear through the distribution equipment ground bus. Provide an equipment grounding conductor connected to the ground bus and equipment ground lug.
- D. Provide two separate grounding conductors for bonding all MCC and switchgear ground buses to the ground grid.
- E. Bond MCC's and/or switchgear fed from other distribution equipment to that equipment.
- F. Bond 480:120/208 V AC transformers and lighting panels to the supplying MCC ground bus.
- G. Ground all equipment fed from lighting panels through the lighting panel ground bus. Provide ground conductors for all connections.
- H. Consider control devices (switches, indicating lights, meters, starters, relays, etc.) mounted in MCC's, switchgear, control panels, or other metal enclosures to be adequately grounded, if the enclosure ground lug or ground bus is properly grounded.
- I. Do not splice grounding conductors.
- J. Run all equipment grounding conductors in conduit.
- K. Provide separate grounding conductors bonded to the ground grid for all DC equipment.
- L. Provide a bare 2/0 conductor bolted to the motor frame and connected to the ground grid for all motors 100 HP and larger.
- M. Ground cranes and hoists in accordance with NEC 610.G.
- N. Bond all lightning protection equipment to the ground grid.
- O. Ground unused and spare power and control cable at both ends.
- P. Size all grounding conductors in accordance with Article of the NEC unless larger size is shown on the Drawings.

3.04 **STRUCTURAL GROUNDING:**

- A. Bond concrete foundation reinforcing steel to the ground at all corners of the structure and at locations along the perimeter. Maximum spacing between bonds shall not exceed 50 FT. Utilize a bare 2/0 conductor, unless otherwise shown on Contract Drawings. Do not use exothermic welding if it will damage the structural integrity of the foundation.
- B. Make all reinforcing steel electrically continuous.

3.05 **TESTING:**

- A. **Ground Resistance Test:**
 - 1. Test resistance of installed ground system after backfilling and prior to system connection to serving utility. Overall system resistance shall not exceed 15 ohms.
 - 2. Test ground grid resistance by fall of potential method.

3. The test shall not be performed immediately following wet weather conditions.
- B. See Section 26 01 26.

END OF SECTION

1.00 GENERAL

1.01 SECTION INCLUDES:

A. Material and installation requirements for:

1. Conduits
2. Conduit fittings
3. Conduit supports
4. Wireways
5. Outlet boxes
6. Pull and junction boxes
7. Cable tray

1.02 DESCRIPTION OF WORK:

- A. Provide electrical raceway and fitting work as shown, scheduled, indicated, and specified.
- B. All electrical conductors shall be installed in conduit or surface metallic raceways. Conduit shall be as specified herein. In addition, empty conduit shall be installed for the voice/data system and for other systems as indicated on the Drawings and in the Specifications.
- C. The types of electrical raceways and fittings required for the project include, but are not limited to, the following.
1. Rigid metallic conduit (RMC) and intermediate metal conduit (IMC),
 2. PVC-coated rigid steel conduit,
 3. Electrical metallic tubing (EMT),
 4. Flexible metal conduit,
 5. Liquidtight flexible metal conduit,
 6. Rigid nonmetallic conduit.

1.03 RELATED SECTIONS:

- A. Section 26 60 00 – Electrical General Provisions
- B. Section 26 60 02 – Basic Materials and Methods

1.04 STANDARDS AND REFERENCES:

- A. All materials and equipment specified herein shall, within the scope of UL Examination Services, be approved by the Underwriter's Laboratories for the purpose for which they are used and shall bear the UL label.
- B. Products and installation shall comply with applicable sections of the following standards:
1. American Iron and Steel Institute (AISI)

2. American National Standards Institute (ANSI):
 - a. C80.1, Rigid Steel Conduit - Zinc-Coated
 - b. C80.3, Electrical Metallic Tubing - Zinc-Coated
 - c. C80.6, Intermediate Metal Conduit - Zinc-Coated
3. ASTM International (ASTM):
 - a. A123, Standard Specification for Zinc Coating (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - b. A153, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 - c. D1784, Standard Specification for Rigid Polyvinyl Chloride (PVC) Compounds and Chlorinated Polyvinyl Chloride (CPVC) Compounds
 - d. D2564, Solvent Cements for PVC Plastic Pipe, Tubing, and Fittings
 - e. E84, Standard Test Method for Surface Burning Characteristics of Building Materials
 - f. F512, Standard Specification for Smooth-Wall PVC Conduit and Fittings for Underground Installation
4. National Electrical Manufacturers Association (NEMA):
 - a. FB 1, Fittings and Supports for Conduit and Cable Assemblies
 - b. OS 1, Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
 - c. RN 1, PVC Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
 - d. TC 3, PVC Fittings for Use with Rigid PVC Conduit and Tubing
 - e. 250, Enclosures for Electrical Equipment (1000 Volts Maximum)
5. Underwriters Laboratories, Inc. (UL):
 - a. 1, Flexible Metal Conduit
 - b. 6, Rigid Metal Conduit
 - c. 50, Standard for Safety Enclosures for Electrical Equipment
 - d. 360, Liquid-Tight Flexible Steel Conduit
 - e. 467, Grounding and Bonding Equipment
 - f. 514A, Standard for Safety Metallic Outlet Boxes
 - g. 514B, Fittings for Cable and Conduit
 - h. 651, Schedule 40 and 80 Rigid PVC Conduit

- i. 797, Safety Electrical Metallic Tubing
- j. 870, Wireways, Auxiliary Gutters, and Associated Fittings
- k. 886, Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations
- l. 1242, Intermediate Metal Conduit

C. All materials and equipment specified herein and their installation methods shall conform to the latest published version of the National Electrical Code, NEC.

1.05 SUBMITTALS

A. Shop Drawings

- 1. See Section 26 60 00.
- 2. Fabrication and/or layout drawings:
 - a. Proposed routing of raceways buried under concrete floors and embedded in concrete walls. Identify conduit by tag number of equipment served or by circuit schedule number.
 - b. Contractor and Control System Integrator shall coordinate to produce detailed underground layout drawings including conduit location to and from all I/O panels, control panels and all equipment, junction boxes and instrumentation for the following process areas:
 - i. Pump Gallery
 - ii. Chemical Feed Area(s)
 - iii. Strainer Area
 - iiii. Feed Channels, Mixers, Flocculators Area
 - iiiii. Blower Room
 - c. Proposed routing and details of construction, including raceway and rebar, for raceways embedded in floor slabs, walls and columns. Identify conduit by tag number of equipment served or by circuit schedule number.
 - d. Proposed location and details of construction for openings in slabs and walls for raceway runs.
 - e. Drawings shall be coordinated with final equipment submittals, including equipment supplied by the Membrane Equipment Supplier.
 - f. Raceway and box submittals shall specifically include proposed area of installation for Engineer review and approval.

1.06 DELIVERY, STORAGE, AND HANDLING:

A. See Section 26 60 00.

2.00 PRODUCTS

2.01 GENERAL:

- A. Provide metal conduit, tubing, and fittings of the type, grade, size, and weight (wall thickness) as shown and required for each service. Where type and grade are not indicated, provide proper selection determined by this Section to fulfill the wiring requirements and complying with the NEC for electrical raceways.
- B. For each electrical raceway system indicated, provide a complete assembly of conduit, tubing, or duct with fittings, including, but not necessarily limited to, connectors, nipples, couplings, expansion fittings, bushings, locknuts, other components and accessories as needed to form a complete system of the type indicated.
- C. Conduit fittings shall be designed and approved for the specific use intended. Conduit fittings, including flexible, shall have insulated throats or bushings. Rigid conduits shall have insulated bushings, except insulated throat grounding bushings shall be used on all conduits without ground conductors and where required by N.E.C. Article 250.

2.02 ACCEPTABLE MANUFACTURERS:

- A. Provide products complying with these specifications and produced by one of the following:
 - 1. Rigid metallic conduits:
 - a. Allied Tube and Conduit Corporation
 - b. Triangle PWC Inc.
 - c. Western Tube and Conduit Corporation
 - d. Wheatland Tube Company
 - e. LTV Steel Company
 - 2. Electrical Metallic Tubing:
 - a. Allied Tube & Conduit Corporation
 - b. ETP-Uni-Couple
 - c. Republic Steel Corporation
 - d. Triangle PWC, Inc.
 - e. Youngstown Sheet & Tube
 - f. Wheatland
 - 3. Flexible Metal and Liquidtight Flexible Metal:
 - a. AFC
 - b. Anaconda Metal Hose
 - c. Electri-Flex Company
 - d. Flexi-Guard, Inc.

- e. Triangle PWC, Inc.
- f. Wheatland
- 4. Rigid Nonmetallic Conduit and Innerduct:
 - a. Carlon
 - b. Cantex
 - c. Triangle PWC, Inc.
- 5. Raceway Fittings:
 - a. Appleton Electric Company
 - b. Cantex (PVC)
 - c. Carlon (PVC)
 - d. Crouse Hinds
 - e. Efcor Division
 - f. ETP-Uni-Couple
 - g. O.Z. Gedney Company
 - h. Raco, Inc.
 - i. Republic Steel Corporation
 - j. Steel City
 - k. Thomas and Betts
- 6. Support systems:
 - a. Unistrut Building Systems
 - b. B-Line Systems Inc.
 - c. Kindorf
 - d. Minerallac Fastening Systems
 - e. Caddy
- 7. Outlet, pull and junction boxes:
 - a. Appleton Electric Co.
 - b. Crouse-Hinds
 - c. Killark
 - d. O-Z/Gedney
 - e. Steel City

- f. Raco
 - g. Bell
 - h. Hoffman Engineering Co.
 - i. Wiegmann
 - j. B-Line Circle AW
 - k. Adalet
8. PVC-coated Rigid Steel:
- a. Allied Tube & Conduit Corporation.
 - b. Flexi-Guard, Inc.
 - c. Occidental Coating Company.
 - d. Perma-Cote.
 - e. Republic Steel Corporation.
 - f. Robroy.
 - g. Triangle PWC, Inc.
 - h. Youngstown Sheet & Tube.
 - i. Wheatland.
9. Wireway:
- a. Hoffman Engineering Company.
 - b. Wiegmann.
 - c. Square D.
10. Precast Handholes, Pull Boxes and Accessories.
- a. Brooks.
 - b. A.B. Chance.
 - c. Utility Vault Company
11. Cable Tray:
- a. Eaton, B-Line
 - b. Legrand
 - c. Chatsworth
 - d. Or reviewed equal.

2.03 RIGID METALLIC CONDUITS

- A. Rigid Galvanized Steel Conduit (RGS):
 - 1. Mild steel with continuous welded seam,
 - 2. Metallic zinc applied by hot-dip galvanizing or electro-galvanizing; threads galvanized after cutting,
 - 3. Internal Coating: Baked lacquer, varnish or enamel for a smooth surface.
 - 4. Standards: ANSI C80.1, UL 6.

 - B. PVC-Coated Rigid Steel Conduit (PVC-RGS):
 - 1. Nominal 40 mil Polyvinyl Chloride Exterior Coating:
 - 2. Coating: Bonded to hot-dipped galvanized rigid steel conduit conforming to ANSI C80.1.
 - 3. The bond between the PVC coating and the conduit surface: Greater than the tensile strength of the coating.
 - 4. Nominal 2 mil, minimum, urethane interior coating.
 - 5. Urethane coating on threads.
 - 6. Conduit: Epoxy prime coated prior to application of PVC and urethane coatings.
 - 7. Female Ends: Have a plastic sleeve extending a minimum of 1 pipe diameter or 2 IN, whichever is less beyond the opening. The inside diameter of the sleeve shall be the same as the outside diameter of the conduit to be used with it.
 - 8. Standards: ANSI C80.1, UL 6, NEMA RN 1.

 - C. Intermediate Metal Conduit (IMC):
 - 1. Mild steel with continuous welded seam,
 - 2. Metallic Zinc Applied by Hot-Dip Galvanizing or Electro-Galvanizing; threads galvanized after cutting,
 - 3. Internal Coating: Baked lacquer, varnish or enamel for a smooth surface.
 - 4. Standards: ANSI C80.6, UL 1242.

 - D. Electrical Metallic Tubing (EMT):
 - 1. Mild steel with continuous welded seam,
 - 2. Metallic zinc applied by hot-dip galvanizing or electro-galvanizing,
 - 3. Internal Coating: Baked lacquer, varnish, or enamel for a smooth surface.
 - 4. Standards: ANSI C80.3, UL 797.
- 2.04 RIGID NON-METALLIC CONDUIT
- A. Schedules 40 (PVC-40) and 80 (PVC-80):

1. Polyvinyl-chloride (PVC) plastic compound which meets, as a minimum, ASTM D1784 cell classification PVC 12233-A, B, or C,
2. Rated for direct sunlight exposure,
3. Fire retardant and low smoke emission,
4. Shall be suitable for use with 90 Deg C wire and shall be marked "maximum 90 Deg C".
5. Standards: ASTM D1784, NEMA TC 2, UL 651.

2.05 FLEXIBLE CONDUIT

A. Flexible Galvanized Steel Conduit (FLEX):

1. Formed of continuous, spiral wound, hot-dip galvanized steel strip with successive convolutions securely interlocked.
2. Standard: UL 1.

B. PVC-Coated Flexible Galvanized Steel (liquid-tight) Conduit (FLEX-LT):

1. Core formed of continuous, spiral wound, hot-dip galvanized steel strip with successive convolutions securely interlocked,
2. Extruded PVC outer jacket positively locked to the steel core,
3. Liquid- and vapor-tight.
4. Standard: UL 360.

2.06 WIREWAY

A. General:

1. Suitable for lay-in conductors,
2. Designed for continuous grounding.

B. Covers:

1. Hinged or removable in accessible areas,
2. Non-removable when passing through partitions.

C. Finish:

1. Rust inhibiting primer and manufacturers standard paint inside and out except for stainless steel type.

D. Standards:

1. UL 870, NEMA 250.

E. Types:

1. Water-tight (NEMA 4X rated) Wireway: Wet, Corrosive and Outdoor Areas

- a. 14 GA Type 304 or 316 stainless steel bodies and covers without knockouts and 10 GA stainless steel flanges.
 - b. Cover: Fully gasketed and held in place with captive clamp type latches.
 - c. Flanges: Fully gasketed and bolted.
2. Dusttight (NEMA 12 rated) Wireway: Indoor Dry Areas
- a. 14 GA steel bodies and covers without knockouts and 10 GA steel flanges.
 - b. Cover: Fully gasketed and held in place with captive clamp type latches.
 - c. Flanges: Fully gasketed and bolted.

2.07 CONDUIT FITTINGS AND ACCESSORIES

A. Fittings for Use with RGS and IMC:

1. In hazardous locations listed for use in Class I, Groups C and D locations.
2. Locknuts:
 - a. Threaded steel or malleable iron,
 - b. Gasketed or non-gasketed,
 - c. Grounding or non-grounding type.
3. Bushings:
 - a. Threaded, insulated metallic,
 - b. Grounding or non-grounding type.
4. Hubs: Threaded, insulated and gasketed, metallic, for rain-tight connection.
5. Couplings:
 - a. Threaded, straight-type: Same material and finish as the conduit with which they are used on.
 - b. Threadless type: Gland compression or self-threading type, concrete tight.
6. Unions:
 - a. Threaded galvanized steel or zinc plated malleable iron.
7. Conduit bodies:
 - a. Body: Zinc plated cast iron or cast copper free aluminum with threaded hubs,
 - b. Standard and mogul size.
 - c. Cover: Clip-on type with stainless steel screws. Gasketed or non-gasketed galvanized steel, zinc plated cast iron or cast copper free aluminum.
8. Sealing fittings:

- a. Body: Zinc plated cast iron or cast copper free aluminum with threaded hubs,
 - b. Standard and mogul size, with or without drain and breather.
 - c. Fiber and sealing compound: UL listed for use with the sealing fitting.
9. Hazardous location flexible coupling (HAZ-FLEX):
- a. Bronze braided covering over flexible brass tubing,
 - b. Liquid tight and arc resistant,
 - c. Bronze end fittings and zinc-plated steel or malleable iron unions and nipples.
10. Expansion couplings:
- a. 4 IN nominal straight-line conduit movement in either direction.
11. Galvanized steel with insulated bushing.
12. Gasketed for wet locations.
13. Internally or externally grounded.
- B. Fittings for Use with PVC-RGS:
- 1. The same material and construction as those fittings listed under paragraph "Fittings for Use with RGS and IMC" and coated as defined under paragraph "PVC Coated Rigid Steel Conduit (PVC-RGS)."
- C. Fittings for Use with EMT:
- 1. Connectors:
 - a. Straight, angle, and offset types furnished with locknuts,
 - b. Zinc plated steel,
 - c. Insulated gland compression type,
 - d. Concrete and rain-tight.
 - 2. Couplings:
 - a. Zinc plated steel,
 - b. Gland compression type,
 - c. Concrete and rain-tight.
 - 3. Conduit bodies (elbows and tees):
 - a. Body: Copper free aluminum with set screw,
 - b. Standard and mogul size.
 - c. Cover: Screw down type with steel screws. Gasketed or non-gasketed galvanized steel or copper free aluminum.

4. Standard: UL 514B.
- D. Fittings for Use with FLEX:
1. Connector:
 - a. Zinc plated malleable iron,
 - b. Squeeze or clamp-type.
 2. Standard: UL 514B.
- E. Fittings for Use with FLEX-LT:
1. Connector:
 - a. Straight or angle type
 - b. Metal construction, insulated and gasketed
 - c. Composed of locknut, grounding ferrule and gland compression nut
 - d. Liquid-tight.
 2. Standard: UL 467, 514B.
- F. Fittings for Use with Rigid Non-Metallic Conduit:
1. Coupling and adapters shall be of the same material, thickness, and construction as the conduits with which they are used.
 2. Standards: UL 651, NEMA TC 3.
 3. Solvent cement for welding fittings shall be supplied by the same manufacturer as the conduit and fittings.
 - a. Standard: ASTM D2564.
- G. Weather and Corrosion Protection Tape:
1. PVC based tape, 10 mils thick,
 2. Protection against moisture, acids, alkalis, salts and sewage and suitable for direct burial,
 3. Used with appropriate pipe primer.
- 2.08 OUTLET BOXES:
- A. Metallic Outlet Boxes:
1. Hot-dip galvanized steel,
 2. Conduit knockouts and grounding pigtail,
 3. Accessories:
 - a. Flat blank cover plates,
 - b. Barriers,

- c. Extension, plaster, or tile rings,
 - d. Box supporting brackets in stud walls,
 - e. Adjustable bar hangers.
 - 4. Standards: NEMA OS 1, UL 514A.
 - B. Cast Outlet Boxes:
 - 1. Zinc plated cast iron or die-cast copper free aluminum with manufacturer's standard finish,
 - 2. Threaded hubs and grounding screw.
 - 3. Styles:
 - a. "FS" or "FD",
 - b. "Bell",
 - c. "EDS" or "EFS" for hazardous locations.
 - 4. Accessories: 40 mil PVC exterior coating and 2 mil urethane interior coating.
 - 5. Standards: UL 514A and 886.
 - C. See Section 26 27 26 for wiring devices, wallplates, and coverplates.
- 2.09 PULL AND JUNCTION BOXES:
- A. NEMA 4 Rated:
 - 1. Body and cover: 14 GA steel finished with rust inhibiting primer and manufacturers standard paint inside and out,
 - 2. Seams continuously welded and ground smooth,
 - 3. No knockouts,
 - 4. External mounting flanges,
 - 5. Hinged or non-hinged cover held closed with stainless steel screws and clamps,
 - 6. Cover with oil resistant gasket.
 - B. NEMA 4X Rated (metallic):
 - 1. Body and cover: 14 GA Type 304 or 316 stainless steel,
 - 2. Seams continuously welded and ground smooth,
 - 3. No knockouts,
 - 4. External mounting flanges,
 - 5. Hinged door and stainless steel screws and clamps,
 - 6. Door with oil-resistant gasket.

- C. NEMA 4X Rated (non-metallic):
 - 1. Body and cover: Ultraviolet light protected fiberglass-reinforced polyester boxes,
 - 2. No knockouts,
 - 3. External mounting flanges,
 - 4. Hinged door with quick release latches and padlocking hasp,
 - 5. Door with oil resistant gasket.

- D. NEMA 12 Rated:
 - 1. Body and cover: 14 GA steel finished with rust inhibiting primer and manufacturers standard paint inside and out,
 - 2. Seams continuously welded and ground smooth,
 - 3. No knockouts,
 - 4. External mounting flanges,
 - 5. Non-hinged cover held closed with captivated cover screws threaded into sealed wells or hinged cover held closed with stainless steel screws and clamps,
 - 6. Flat door with oil resistant gasket.

2.10 HANDHOLES AND VAULTS:

- A. Handholes and vaults shall be 48" X 48" X 48" deep minimum size or as shown on drawings. All handholes and vaults shall be of reinforced concrete construction and shall have concrete bottoms with sumps. All handholes and vaults shall be provided with galvanized "C" channels and galvanized irons. Reference standard details.
- B. Frame and covers shall be hinged watertight of 3/16" diamond plate or galvanized steel and shall be suitable for H-20 wheel loading.
- C. Covers shall be provided with a piston for easy opening; piston and latching mechanism shall hold the cover in the open position at 90°.
- D. Handholes, vaults and covers shall be constructed per standards and quality of Utility Vault Company 444 LA, or approved equal. Covers shall be Utility Vault Company No. 3030-P or equal.

2.11 SUPPORT SYSTEMS:

- A. Multi-conduit surface or trapeze type support and pull or junction box supports:
 - 1. Material requirements.
 - a. Galvanized steel: ASTM A123 or ASTM A153.
 - b. Stainless steel: AISI Type 316.
 - c. PVC coat galvanized steel: ASTM A123 or ASTM A153 and 20 mil PVC coating.

- d. Fiberglass: Fire-retardent polyester or vinylester resin, ASTM E84, UL 94.
- B. Single conduit and outlet box support fasteners:
 - 1. Material requirements:
 - a. Zinc plated steel
 - b. Stainless steel
 - c. Malleable iron
 - d. PVC coat malleable iron or steel: 20 mil PVC coating
 - e. Steel protected with zinc phosphate and oil finish.
- 2.12 OPENINGS AND PENETRATIONS IN WALLS AND FLOORS:
 - A. Sleeves, smoke and fire stop fitting through walls and floors:
 - 1. See Section 01800.
- 2.13 SMOKE AND FIRE STOP FITTINGS:
 - A. 3 HR UL rating.
 - B. Flanged and segmented.
 - C. Cast malleable iron mounting frame and pressure plate.
 - D. Elastomeric sealing material.
 - 1. Steel clamping hardware.
- 2.14 SLEEVES THROUGH WALLS AND FLOORS:
 - A. Uncoated or galvanized iron or steel:
 - B. Wall thickness: Not less than standard Schedule 40 pipe.
- 2.15 CABLE TRAY:
 - A. Material: Hot dipped galvanized.
 - B. Minimum Size:
 - 1. 12” wide x 4” deep.
 - 2. Power, control, and signal wiring shall be separated per specification 260519.3.05; provide extra tray(s), cable attachment hardware, or tray dividers as required.
 - C. Supports, fittings, fastening hardware, and appurtenances: Provide as required; install per manufacture’s requirements.
 - 1. Tray drop/rise fittings, cable/wire drop fittings.
 - 2. Conduit to tray connectors.
 - 3. Tray Cover: Trays shall be covered from start to finish, size as required.

- 4. All fastening hardware shall be stainless steel.
- D. Grounding: Provide and install manufacture ground bolts and wire supports per manufacture and NEC as required.
- E. Cable Tray Identification: Trays shall be labeled to provide indication of all circuits extending through tray; see conduit and wire schedules on plan.
- F. Tools: Manufacture recommended tools shall be provided and utilized.
- G. Manufacture: Eaton – B-Line, FLEXTRAY Wire Basket, or engineered reviewed equal.

3.00 EXECUTION

3.01 INSTALLATION:

- A. General:
 - 1. Install electrical raceways and fittings as shown in accordance with the manufacturer's written instructions, the applicable requirements of the NEC, and in accordance with recognized industry practices to ensure that products serve the intended function. Complete electrical raceway installation before starting the installation of wire and cable.
- B. Conduit Size:
 - 1. Minimum conduit size for power wiring shall be $\frac{3}{4}$ ", except that $\frac{3}{8}$ " flexible metallic conduit may be used for fixture whips. Maximum conduit size for EMT shall be 2". Minimum conduit size for control wiring shall be $\frac{3}{4}$ ". Minimum conduit size for voice/data wiring shall be 1".
- C. Rigid Steel and Intermediate Metal Conduit:
 - 1. Use rigid steel or intermediate metal conduit to run all electrical raceway systems where exposed to weather; in damp, wet or corrosive locations; where subject to physical damage; and where cast in concrete walls or floors slabs which have waterproof membranes and where cast in masonry walls. All buried conduit sweeps shall be rigid steel. Use rigid steel or IMC conduit for all exposed feeders. IMC conduit shall not be used in sizes larger than 4". Use threaded type couplings and fittings. Split type couplings and fittings are not acceptable. The interior of all buildings shall be considered a damp, wet or corrosive area (excluding rooms identified on the drawings as "non-architecturally finished").
- D. PVC Rigid Coated Steel:
 - 1. Use PVC rigid coated steel in outdoor, hazardous classified areas, where exposed, for all 480 Volt feeders in the Chemical Feed Area, where exposed, and for raceways in the Chemical Feed Area installed where subject to physical damage. The interior of vaults shall not be considered exposed. Use for headworks process room.
- E. Electrical Metallic Tubing (EMT):

1. Use EMT for branch circuit electrical raceway systems where concealed in furred ceilings or in walls; exposed inside where not exposed to physical damage. EMT conduit shall not be installed where exposed to weather or in wet or corrosive locations. Use compression type fittings, couplings and connectors made-up tight for all conduit sizes.
- F. Liquidtight Flexible Metal:
1. Use liquidtight flexible metal conduit and fittings for all motor connections, and for other electrical equipment connections where subject to movement and vibration and when subject to one or more of the following conditions: (1) exterior locations, moist or humid atmosphere where condensation can be expected to accumulate; (2) corrosive atmosphere, subject to water spray; subject to dripping oil, grease or water. Install internal ground wire in flexible conduit with grounding bushings. Maximum length shall be 6'0" and minimum length shall be 3'0".
- G. Rigid Nonmetallic:
1. Use PVC conduit directly buried in earth, concrete encased, cast in concrete slabs, and where subject to corrosive environment. PVC may be used for all raceways on the interior of the building, which do not contain 480 volt conductors or motor feeders, or are otherwise not permitted as outlined in the paragraphs above. Use Schedule 40 where direct buried and Schedule 80 where exposed, with size adjusted to have same fill area as if Schedule 40 were used.
- H. Pull and Junction Boxes:
1. NEMA 12:
 - a. Acceptable for use: non-architecturally finished areas
 - b. Not acceptable for use: outdoors, wet areas, corrosive areas, vaults
 2. NEMA 4:
 - a. Acceptable for use: non-architecturally finished areas, wet areas
 - b. Not acceptable for use: outdoors, corrosive areas, vaults
 3. NEMA 4X (metallic):
 - a. Acceptable for use: non-architecturally finished areas, outdoors, wet areas, corrosive areas, vaults
 - b. Not acceptable for use: Chemical Feed Area
 4. NEMA 4X (non-metallic):
 - a. Acceptable for use: Chemical Feed Area, vaults, wet areas, corrosive areas
 - b. Not acceptable for use: non-architecturally finished areas, outdoors, areas subject to physical damage
 5. Hazardous Classified Areas: Use appropriate type per NFPA 70.

3.02 INTERIOR CONDUIT SYSTEM:

- A. Ground all metallic conduit in accordance with the requirements of the latest edition of the NEC.
- B. Install all conduit as a complete system without conductors, continuous from outlet to outlet and from fitting to fitting. Make up threaded joints of conduit carefully in such a manner as to ensure a tight joint. Field-cut threads shall be cold-galvanized after cutting. The entire conduit system shall be secured at all joints and boxes in such a manner that each system shall be electrically continuous throughout. Fasten the entire conduit system securely into position. A run of conduit between outlet and outlet, between fitting and fitting, or between outlet and fitting shall not contain more than the equivalent of four quarter bends, including those bends located immediately at the outlet or fitting. Install approved expansion fittings in all conduit runs as specified in paragraph 3.2.P.
- C. Ream all ends of conduit properly to remove rough edges. Whenever a rigid steel or IMC conduit enters a switchboard, panelboard, enclosure, or box it shall be securely fastened by the use of a locknut inside and outside and an approved insulating bushing shall be installed. Insulated grounding bushings shall be installed on all conduits without ground conductors and where required by NEC Article 250. Whenever an EMT conduit enters a switchboard, panelboard, enclosure, or box it shall be securely fastened by use of an insulated throat connector or a connector with an insulating bushing. Lay out and install all conduit systems as to avoid all other services or systems, the proximity of which may prove injurious to the conduit or the wires or conductors which the conduit confines.
- D. Conceal conduit systems in finished areas. Concealed metallic conduits shall be run in a direct manner, basically parallel to, and at right angles with the lines of the building, and with as long a bend as possible. Conduit may be exposed in mechanical rooms and where otherwise shown or indicated. On exposed systems, run the conduit parallel or perpendicular to the structural features of the building and rigidly support with malleable iron conduit clamps at intervals as required by NEC, or on conduit racks, neatly racked and bent in a smooth radius at corners insofar as practicable. All bends shall be field-made using an approved bending machine designed for the purpose, or using standard ells having a radius not less than that required by the National Electrical Code, and with approved fittings or connectors. All bends shall be free from dents or flattening.
- E. All conduit shall be run without traps. Where traps are unavoidable, a junction or pull box shall be placed at the low point. Metallic conduit systems, which are exposed to the weather or water, shall be made watertight. As soon as conduit has been permanently installed in place, conduit shall be capped or plugged with standard accessories. All metallic conduit shall be swabbed after plaster and drywall is finished and dry.
- F. Support exposed raceway or grouped concealed raceways on galvanized channel using compatible galvanized fittings (bolt, beam clamps, and similar items) and galvanized threaded rod pendants to secure raceway to channel and channel to structure. Support single conduit runs using a properly sized galvanized conduit hanger with galvanized closure bolt/nut and threaded rod. Support-spacing shall not exceed 10' apart for all EMT/IMC conduit and rigid conduit 2" and smaller, and 15' apart for rigid conduit 2-1/2" and larger and within 3' from boxes and changes in direction. Support flexible conduit on maximum 4-1/2' centers and within one foot (1') of boxes. All raceway support system materials shall be galvanized and manufactured by

Kindorf, Unistrut, Superstrut, Caddy, or Spring Steel Fasteners, Inc. Provide chrome or nickel-plated escutcheon plates on all conduit passing through walls and ceilings in finished areas.

- G. Support 1” and smaller EMT conduit concealed in ceiling cavities with No. 13 AWG galvanized iron wire pendants, spaced not to exceed 10’ apart and 3’ from boxes and changes in direction, secured to conduit with clips and properly secured to structure. Perforated strap shall not be used for conduit supports. Support conduit sized one inch (1”) and larger as described in Paragraph F.
- H. Make all joints and connections to ensure mechanical strength and electrical continuity. PVC conduit shall be joined, or have fittings attached, by using a fusing (solvent) compound recommended by and applied as instructed by, the conduit manufacturer.
- I. Run conduit to avoid proximity to heat producing equipment, piping and flues, keeping a minimum of 8” clear. Whenever possible, install horizontal raceway runs above water piping. Unless shown otherwise, do not install conduit horizontally in concrete slabs without written approval. All roof penetrations shall be made in adequate time to allow the roofer to make proper flashings.
- J. Carefully review architectural, structural, mechanical, plumbing, and electrical Drawings and place boxes and conduit to avoid conflicts with structural members or other general construction.
- K. Conduit larger than ¾” shall not be embedded in structural slabs without prior written permission from the Engineer. Conduits embedded in structural slabs shall be installed in the middle of the slab below the top and above the bottom reinforcing steel. Maintain a minimum concrete coverage of one (1”) except where penetration is made.
- L. Furnish sleeves for timely placing in construction for all conduit passing through concrete walls, partitions, beams, floors, and roofs while same are under construction.
- M. All conduit passing through the housing on connected equipment, shall pass through a cleanly cut hole protected with an approved grommet.
- N. Metallic conduit installed below grade shall have its entire length painted with two coats of protective finish unless encased in concrete. Each coat shall consist of 5 mils of PPG “Coat Cat Epoxy Coating” applied in accordance with the manufacturer’s recommendations. The entire length of metallic conduit, including fittings, shall be protected to a point 6” above finished grade (or concrete slab).
- O. Coordinate locations of raceways in fire rated partitions so as not to affect the fire rating of the partition. Notify the Engineer in writing where additional construction is required to maintain the partition fire rating.
- P. Install expansion fittings in all conduit as follows:
 - 1. All conduits crossing building expansion joints; unless some other form of thermal expansion compensation is approved in writing by the Engineer,
 - 2. All conduit straight runs in excess of 200’, and 400’ centers in all longer conduit runs.
 - 3. Conduit entering environmental rooms,
 - 4. Locations subject to thermal expansion and as required by NEC.

5. Unless expansion fitting has an integral bonding braid, an external braid approved for the purpose shall be installed around the fitting.

Q. Cable Tray:

1. Cable tray shall be installed per manufacture and NEC requirements. Minimum height/clearance shall be 8' from the bottom of the tray to the finished floor; coordinate installation with all other equipment and clearance requirements. Cable tray shall be provided and installed as a complete and fully functional system.

3.03 EXTERIOR CONDUIT SYSTEMS

- A. Exterior conduit systems shall meet all of the general installation requirements for interior conduit systems.
- B. All exterior conduit systems shall be completely watertight. All hangers, fasteners, and supports used with exterior conduit systems shall be stainless steel.
- C. Install underground conduits with sealing glands equal to OZ Type "FSK" or approved equal exterior to entrance and OZ Type "CSB" or approved equal interior to entrance at points where conduits enter the building, to prevent water seepage.
- D. Install conduits outside the building lines a minimum of 30" below grade, unless noted otherwise on the Drawing. Maintain 12" of earth or 2" of concrete separation between electrical conduits and other services or utilities below grade. Maintain 10'0" separation between parallel underground power and voice/data conduits. Where power and voice/data conduits cross below grade, crossing shall be at right angles (90 degrees) with a minimum 2'0" vertical separation.

3.04 HANDHOLES AND VAULTS

- A. Sizes of handholes and vaults shown on the drawings are minimum sizes. If space allows the Contractor may upsize the structures for ease of pulling or if required by the NEC.
- B. Conduits entering energized equipment shall have both conduit ends sealed with a waterproof duct sealing compound - WATERGUARD Industrial Encapsulant or equal. Where conduits enter through sides of handholes the penetration shall be made watertight.
- C. Provide a minimum of 10" of drainage gravel under entire surface of all vaults and handholes.
- D. All wire installed in handholes and vaults shall be neatly bundled and racked to the handhole or vault side walls.
- E. Provide welded stainless steel nameplate on each handhole and vault cover with the tag number and contents (480v, 120v, power, control, signal, etc.) clearly indicated.

3.05 VOICE/DATA AND SIGNAL SYSTEM RACEWAYS:

- A. General: Conduit shall be installed in accordance with the previous specified requirements for conduit and tubing and with the additional requirements that no length of run shall exceed 50' for ¾" trade sizes, and 100' for one inch (1") or larger trade sizes, and shall not contain more than two 90 degree bends or the equivalent thereof. Pull or junction boxes shall be installed to comply

with these requirements. Empty voice/data and signal system raceways shall include a pull wire or cord, as described in Paragraph 3.8 herein below. Install innerducts with pullcords in raceways where noted.

3.06 EMPTY CONDUIT RACEWAY SYSTEMS:

- A. General: Empty conduit in which wire is to be installed by others shall have pull wires installed. The pull wire shall be No. 14 AWG zinc-coated steel, or plastic having not less than 200 pounds tensile strength. Not less than 12” of slack shall be left at each end of the pull wire.

3.07 IDENTIFICATION:

- A. See Section 26 60 02 for applicable labeling requirements.
- B. Conduit Markers
1. All conduits scheduled or shown on the drawings shall be identified at each end with a permanent stamped aluminum conduit tag. Conduits shall be labeled as identified on the Conduit and Wire Schedule or based on panelboard and circuit. Additional conduits shall be given unique identifiers consistent with the design documents. Attach tags to cables or conduit by using nylon cable ties. Identify concealed conduits entering equipment, panelboards, or enclosures by attaching marker tag to cables as they exit the conduit. Embedded conduits and conduits routed underground shall be labeled also at all points of entry and exit including handholes and buildings, by attaching a marker tag to the exterior of the conduit.

3.08 FIELD INSPECTION

- A. Prior to backfilling and encasing conduits installed underground or covering conduits concealed in walls and ceilings, all raceways shall be inspected by the Engineer. Engineer shall be contacted a minimum of one week in advance for field inspection of concealed raceway. No raceway shall be concealed or backfilled until inspected by the Engineer.

END OF SECTION

1.00 GENERAL

1.01 SECTION INCLUDES:

A. Material and installation requirements for:

1. Step-down dry type transformers.

1.02 DESCRIPTION OF WORK:

A. This section covers furnishing and installing dry type, step-down transformers for supplying 208Y/120V building power requirements from the 480 volt primary system.

1.03 RELATED SECTIONS:

A. Related Sections include but are not necessarily limited to:

1. Section 26 60 00 – Electrical General Provisions
2. Section 26 60 02 – Basic Materials and Methods
3. Section 26 05 26 – Grounding
4. Section 26 24 16 – Panelboards

1.04 STANDARDS AND REFERENCES:

- A. All materials and equipment specified herein shall, within the scope of UL Examination Services, be approved by the Underwriter's Laboratories for the purpose for which they are used and shall bear the UL label.
- B. All materials and equipment specified herein shall conform with all applicable NEMA, ANSI and IEEE Standards
- C. All materials and equipment specified herein and their installation methods shall conform to the latest published version of the National Electrical Code, NEC.

1.05 EQUIPMENT SIZE:

A. Electrical equipment shall fit in the space provided on the plan drawings or as specified. Equipment heights shall not exceed those shown or specified. Larger equipment shall not be considered acceptable. Equipment that is larger than specified shall not be considered equivalent.

1.06 SUBMITTALS:

A. Shop Drawings

1. See Section 26 60 00.

B. Catalog data showing material information and conformance with specifications.

C. Manufacturer name and address.

D. Accessories.

E. Proposed detail for wall mounting for Engineer review and approval.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. See Section 26 60 00.

2.00 PRODUCTS

2.01 TYPE:

- A. Dry type transformers shall be constructed of heavy gauge sheet steel. Coil and terminal chamber shall be constructed with guarded opening for ventilation and convection cooling. Primary coil shall be delta connected, secondary coil wye connected. Conductors shall be copper.

2.02 WINDINGS:

- A. General purpose transformers

- 1. Separate primary and secondary windings shall have Class H insulation and shall be rated for continuous operation at rated kVA with temperature rise of not over 150 degrees C above a 40 degree C ambient, with a maximum hot spot temperature of 220 degrees C. Windings, core and coil assembly shall be treated and built to resist the effects of dirt and moisture.

2.03 PRIMARY TAPS:

- A. General purpose transformers

- 1. Unless otherwise noted or shown, transformers shall be provided with a minimum of four full capacity taps, minimum of two 2-1/2 percent above and two 2-1/2 percent below normal (rated) primary voltage.

2.04 CAPACITY:

- A. Transformers furnished shall have a continuous rating of not less than the size noted on the drawings.

2.05 CONNECTIONS:

- A. Provisions for external connections shall be made by means of a terminal board employing lugs compatible for the external conductors to be installed.

2.06 GROUNDING:

- A. The core of the transformer shall be grounded to the enclosure by means of a flexible grounding conductor sized in accordance with applicable NEMA, IEEE ANSI standards.

2.07 NOISE LEVEL:

- A. ASA rated quiet type.

2.08 EQUIPMENT:

- A. Acceptable manufacturers for dry type transformers shall be:

- 1. General Electric,

2. Westinghouse,
 3. Square D,
 4. Heavy Duty
 5. and approved equals.
- B. Provide manufacturer's wall mounting bracket and accessories for all wall mounted transformers. Submit information and proposed mounting to Engineer. Any additional supports required by the Structural Engineer shall be installed at no additional cost to the Owner.

3.00 EXECUTION

3.01 INSTALLATION:

- A. Transformers shall include internal "rubber-in-shear" isolation mounts selected per manufacturer's recommendations or shall be installed with "KORFUND" or equal external vibration isolators. Wall mounting shall be allowed on masonry. Mounting hardware shall be per manufacturer's instructions. Transformers with enclosures designed for floor mounting where suspended from above shall be suspended on a trapeze constructed of a minimum of two horizontal structural channels hung from threaded rod attached to structural slab with inserts. Channel rod and inserts shall be sized for not less than 400% load safety factor. Transformer raceway connections shall be flexible metal conduit as specified herein-before for equipment subject to vibration.

3.02 CONNECTION:

- A. Transformers shall be considered "grounded neutral separately derived systems" and neutral shall be grounded accordingly to the building ground grid utilizing a direct connection.

3.03 IDENTIFICATION:

- A. The transformer shall be identified with phenolic nameplates. Nameplates shall be white background with 1/4" black letters, secured in place with screws.
- B. The nameplate shall state the following:

EXAMPLE

Rating: 480V-120/208, 3ø

Primary Source: Primary Breaker at Panel P1

****END OF SECTION****

1.00 GENERAL

1.01 SECTION INCLUDES:

A. Material and installation requirements for:

1. Power distribution panelboards
2. Surge protection components

1.02 DESCRIPTION OF WORK:

A. This section covers furnishing and installing all panelboards and enclosure work, including cabinets, as shown, scheduled, indicated, and specified.

1.03 RELATED SECTIONS:

A. Related Sections include but are not necessarily limited to:

1. Section 26 60 00 – Electrical General Provisions
2. Section 26 60 02 – Basic Materials and Methods
3. Section 26 01 26 – Testing
4. Section 26 05 19 – Wire and Cable
5. Section 26 05 26 – Grounding
6. Section 26 05 33 – Raceways
7. Section 26 22 00 – Low Voltage Transformers
8. Section 26 28 00 – Overcurrent Protective Devices

1.04 STANDARDS AND REFERENCES:

A. All materials and equipment specified herein shall, within the scope of UL Examination Services, be approved by the Underwriter's Laboratories for the purpose for which they are used and shall bear the UL label.

B. Products shall be designed, manufactured, tested, and installed in compliance with the following standards:

1. National Electrical Manufacturers Association (NEMA):
 - i) AB 1, Molded Case Circuit Breakers.
 - ii) PB 1, Panelboards.
 - iii) PB 1.1, Instruction for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
2. Underwriters Laboratories, Inc. (UL):
 - i) UL 1449, Standard for Safety, Transient Voltage Surge Suppressors.

C. All materials and equipment specified herein and their installation methods shall conform to the latest published version of the National Electrical Code, NEC.

1.05 SUBMITTALS:

A. Shop Drawings

1. See Section 26 60 00.

1.06 DELIVERY, STORAGE, AND HANDLING:

A. See Section 26 60 00.

B. Deliver panelboards in factory-fabricated, water-resistant wrapping.

C. Handle panelboards carefully to avoid damage to material component enclosure, and finish.

D. Store panelboards in a clean, dry space and protect from the weather.

2.00 PRODUCTS

2.01 GENERAL:

A. Panelboards shall be dead front safety type equipped with molded case circuit breakers as shown and scheduled.

2.02 ACCEPTABLE MANUFACTURERS:

A. Provide products complying with these specifications and produced by one of the following:

1. General Electric Company

2. Square D Company

3. Siemens

2.03 MATERIALS AND COMPONENTS:

A. Busing Assembly

1. Panelboard busing shall be tin-plated 55% conductivity aluminum, plated by the latest Alstan process. Bus structure and mains shall have ratings as shown and scheduled and shall be phase sequence construction. Such ratings shall be established by heat rise tests with maximum hot spot temperature on any connector or busbar not to exceed 65 degree Celsius rise above 40 degrees Celsius ambient. Heat rise test shall be conducted in accordance with UL 67. The use of conductor dimensions will not be accepted instead of actual heat tests. All bus joints shall be bolted with medium carbon steel, zinc, or cadmium plated hardware equipped with lock washers and torqued to the manufacturer's recommended settings (usually ASTM standards). All bolted connections shall have Belleville washers. Furnish a bare un-insulated, or an isolated, where noted, ground bus inside each panelboard enclosure and elsewhere where noted on the Drawings. Furnish an isolated full size neutral bus, insulated where noted, in all panels where the neutral is present.

B. Molded Case Circuit Breakers

1. Circuit breakers shall be of the molded case; thermal magnetic type equipped with individually insulated, braced and protected connectors. The front faces of all circuit breakers shall be flush with each other. Tripped indication shall be clearly shown by the breaker handle taking a position between “ON” and “OFF”. Provisions for additional breakers shall be such that no additional connectors will be required to add breakers. Circuit breakers shall be such that no additional connectors will be required to add breakers. Circuit breakers shall bolt on the main bus. All 2 and 3-pole breakers shall have common trips.
2. All single-pole circuit breakers shall be either ambient or case-compensated (calibrated 40 degrees Celsius) thermal-magnetic type breakers, with inverse time delay on overloads and instantaneous magnetic trip on short circuits. (Twin, tandem, and half-size single-pole breakers. Breaker tie handles are not acceptable). All multiple breakers shall be common trip, thermal-magnetic type and calibrated 40 degrees Celsius.
3. The breakers shall employ quick-make, toggle mechanism for manual operation, as well as automatic operation. The breakers shall have provisions for manually testing the tripping mechanism with the breaker removed from the panel. Automatic tripping shall be indicated by the breaker handle assuming a clearly distinctive position from the manual “on” and “off” positions.
4. Circuit breakers used as switches in fluorescent lighting circuits shall be approved for such switching duty and shall be marked “SWD”.
5. Provide panelboard circuit breakers with interrupting capacity as shown, but in no case less than the following symmetrical amperes RMS:

Voltage (volts)	Interrupting Capacity
120/240	10,000 AIC
277/480	22,000 AIC

6. Current limiting thermal-magnetic circuit breakers suitable for interrupting currents up to 200,000 amperes shall be provided where scheduled or specified. Current limiting breakers shall have a non-fusible type, independently operating limiter section in series with each pole, which shall automatically reset after circuit interruption. Current limiting circuit breakers shall be equal to Square D Company “I-LIMITER”. Standard thermal-magnetic circuit breakers capable of operation and interrupting currents up to 200,000 amperes may be acceptable with the Engineer’s written approval.
7. Ground fault interrupter (GFI) circuit breakers, where shown, shall be 5 ma ground fault trip and shall include a TEST button.
8. Ground equipment protection (GFEP) circuit breakers, where shown, shall be 30 ma ground fault trip and shall include a TEST button.

C. Lugs

1. Panelboards and distribution panels shall be provided with main lugs, main over-current devices, and feed-thru lugs as noted on the Drawings. Lugs shall be suitable for use with the cable size and material installed. Panel wire-ways shall provide adequate space for wiring to all lugs.

- D. Spaces
 - 1. Where space for future breakers is shown, panelboards enclosure shall include removable blank panels or knockouts to allow installation of future breakers and panelboard busing shall be complete, including all required connectors.
- E. Integrated Equipment Rating
 - 1. Each panelboard, as a complete unit, shall have a short-circuit rating equal to the interrupting rating of the weakest over-current devices, and feed-thru lugs as noted on the Drawings, where applicable. Such ratings shall have been established by tests on similar panelboards with the circuit breakers installed.
- F. Panelboard Enclosures
 - 1. Provide galvanized steel enclosures, NEMA Type 12 for indoor locations, NEMA 3R for outdoor locations, minimum 16 gauge thickness, minimum 20" width, with multiple knockouts, unless shown otherwise. Provide doors with concealed hinges, spring-loaded doors pulls, flush lock and key, all panelboard enclosures keyed alike, equipped with interior circuit directory frame, card and clear plastic covering for all lighting and appliance panelboards. Door and trim shall be painted with manufacturers standard gray enamel finish over a rust inhibitor. Trim on flush mounted panels shall have concealed fasteners. Enclosure shall be for recessed or surface mounting as shown. Enclosures shall be fabricated by the same manufacturer as panelboards to be enclosed. Multi-section panelboards shall have separate covers and trims. Multi-section panelboards shall be installed side by side with covers butted together.

2.04 TRANSIENT VOLTAGE SURGE SUPPRESSION (SURGE PROTECTIVE DEVICES):

- A. Service entrance rated panelboards shall be provided with a transient voltage surge suppression system for the protection of all AC electrical circuits from the effects of lightning-induced currents, substation switching transients, and internally generated transients resulting from inductive and/or capacitive load switching.
- B. Suppressors shall be listed in accordance with UL 1449, Standard for Safety, Transient Voltage Surge Suppressors.
- C. Suppressors shall be mounted internal to and integral with the panelboard.
- D. Suppressors shall be provided with dry contacts output to monitor alarm status.
- E. Suppressor shall be provided with surge counter which displays the combined total number of transient voltage surges detected.
- F. Visible indication of proper suppressor connection and operation shall be provided and shall be visible without removal of the panel deadfront.
- G. The mounting position of the suppressor shall permit a straight and short lead length connection between the suppressor and the point of connection to the main bus.
- H. Suppressors shall meet or exceed the following criteria:
 - 1. Peak Surge Current Rating Per Phase (based on 8/20us Waveform): 120,000 Amps.

2. Maximum Clamping Voltage Rating (Tested to ANSI/IEEE C62.41-1980 Cat. B, 6000V, 1.2/50us, 3000A 8/20 us Waveforms): 600 Volt
3. Transient Joule Rating/Phase (Based on 10/1000 μ s Waveforms): 920 Joules
- I. Units may be manufactured using Metal Oxide Varistors (MOV's) as primary suppression component, or as a "hybrid" system using MOVs, Gas Tubes, Inductors, capacitors, and/or diodes. However, units relying solely on gas tubes or diodes are not acceptable.
- J. Suppressors shall be of solid-state componentry and shall operate bidirectionally.
- K. Suppressors shall be of Square D IMA series, or approved equal.

3.00 EXECUTION:

3.01 INSTALLATION OF PANELBOARDS AND ENCLOSURES:

- A. Install panelboards and enclosures as shown; including electrical connections, in accordance with the manufacturer's written instructions, the applicable requirements of NEC, the NECAs "Standard of Installation", and recognized industry practices to ensure that products serve the intended function.
- B. Coordinate installation of panelboards and enclosures with cable and raceways installation work. Verify that wall thickness is adequate where recessed panels are shown.
- C. Anchor enclosures firmly to walls and structural surfaces ensuring that they are permanently and mechanically secured.

3.02 TESTING:

- A. Prior to energization, check for continuity of circuits and for short circuits.
- B. Thermographic Testing
 1. Refer to Section 26 01 26, "Electrical Testing", for thermographic testing.

3.03 IDENTIFICATION:

- A. Refer to Section 26 60 02 for applicable labeling requirements and nameplates.
- B. Circuit Index Card
 1. Type the enclosure's circuit directory card upon completion of work.
 2. Refer to Section 26 60 02 for additional requirements.

END OF SECTION

1.00 GENERAL

1.01 SECTION INCLUDES

A. Material and installation requirements for:

1. Light switches
2. Receptacles
3. Device wallplates and coverplates

1.02 DESCRIPTION OF WORK

A. This section covers furnishing and installing all receptacles, switches and other wiring devices indicated on the drawings.

1.03 RELATED SECTIONS

A. Related Sections include but are not necessarily limited to:

1. Section 26 60 00 – Electrical General Provisions
2. Section 26 60 02 – Basic Materials and Methods
3. Section 26 05 33 – Raceways

1.04 STANDARDS AND REFERENCES

A. All materials and equipment specified herein shall, within the scope of UL Examination Services, be approved by the Underwriter's Laboratories for the purpose for which they are used and shall bear the UL label.

B. Products shall be designed, manufactured, tested, and installed in compliance with the following standards:

1. National Electrical Manufacturers Association (NEMA):
 - a. NEMA 250, Enclosures for Electrical Equipment (1000 Volts Maximum)
 - b. NEMA WD-1, General Purpose Wiring Devices
 - c. NEMA WD-5, Specific Purpose Wiring Devices
 - d. NEMA WD-6, Wiring Devices – Dimensional Requirements
2. Underwriters Laboratories, Inc. (UL):
 - a. UL 20, General Use Snap Switches
 - b. UL 498, Attachment Plugs and Receptacles
 - c. UL 514A, Metallic Outlet Boxes
 - d. UL 894, Safety Switches for Use in Hazardous (Classified) Locations
 - e. UL 943, Ground-Fault Circuit-Interrupters

- f. UL 1010, Receptacle-Plug Combinations for Use in Hazardous (Classified) Locations
- C. All materials and equipment specified herein and their installation methods shall conform to the latest published version of the National Electrical Code, NEC.
- 1.05 SUBMITTALS:
 - A. Shop Drawings
 - 1. See Section 26 60 00.
- 1.06 DELIVERY, STORAGE, AND HANDLING:
 - A. See Section 26 60 00.
- 2.00 PRODUCTS
- 2.01 GENERAL:
 - A. Provide factory-fabricated wiring devices in the type, color, and electrical rating for the service indicated. Where type and grade are not indicated, provide proper selection to correspond with branch circuit wiring and over-current protection. Attachment of wires to devices shall be by screw pressure under the head of binding screws. Arrangements depending on spring pressure or tension are not acceptable. All binding screws shall be brass or bronze.
- 2.02 ACCEPTABLE MANUFACTURERS:
 - A. Provide products complying with these specifications and produced by one of the following:
 - 1. Light switches and receptacles (except explosion proof):
 - a. Hubbell
 - b. Bryant
 - c. Pass & Seymour
 - d. Arrow Hart
 - e. General Electric
 - f. Leviton
 - g. Or approved equal.
 - 2. Explosion proof light switches and receptacles:
 - a. Crouse Hinds
 - b. Appleton Electric
 - c. Killark
 - d. Or approved equal.
- 2.03 LIGHT SWITCHES

- A. General requirements unless modified in specific requirements paragraph of switches per designated areas or types:
1. Toggle type, quiet action, Standard Specification grade,
 2. Self grounding with grounding terminal,
 3. Back and side wired
 4. Solid silver cadmium oxide contacts,
 5. Rugged area housing and one-piece switch arm,
 6. Rated 20 A, 120/277 VAC,
 7. Switch handle color: Ivory,
 8. Types as indicated on the Drawings:
 - a. Single pole
 - b. Double pole
 - c. 3-way
 - d. 4-way
 9. Standards: UL 20, 514A; NEMA WD-6
- B. Dry Non-architecturally Finished Areas:
1. Coverplate: Zinc plated malleable iron or galvanized steel. Single or multiple gang as required.
- C. Corrosive Areas:
1. Corrosion resistant nickel plated metal parts. Vaults
 2. Coverplate: Gasketed zinc plated malleable iron or copper free aluminum with stainless steel screws utilizing rocker, front mounted toggle or pull type switch. Single or multiple gang as required.
- D. Highly Corrosive Areas: Filtration Building Chemical Feed Area
1. Corrosion resistant nickel plated metal parts.
 2. Coverplate: PVC coated zinc plated malleable iron or copper free aluminum with stainless steel screws utilizing rocker, front mounted toggle or pull type switch. Single or multiple gang as required.
- E. Hazardous Areas: Headworks
1. Rated for Class I, Division 1 and 2, Groups B, C, and D and Class II, Division 1 and 2 areas, Groups E, F, and G.
 2. Switch enclosed in separate sealing chamber. Sealing chamber has prewired factory sealed pigtail leads.

3. Coverplate: Zinc plated malleable iron or copper free aluminum with stainless steel screws utilizing rocker or front mounted toggle type switch. Single or multiple gang as required.
4. Standards: UL 894.

2.04 RECEPTACLES

- A. General requirements unless modified in specific requirements paragraph of receptacles per designated areas:
 1. Straight blade, Standard Specification grade,
 2. Brass triple wipe line contacts,
 3. One piece grounding system with double wipe brass grounding contacts and self grounding strap,
 4. Back and side wired,
 5. Rated 20 A, 125 VAC,
 6. High impact nylon body,
 7. Receptacle body color:
 - a. Ivory
 8. Types as indicated on the Drawings:
 - a. Normal: Self grounding with grounding terminal
 - b. Ground fault circuit interrupter: Feed-through type with test and reset buttons
 9. Duplex or simplex as indicated on the Drawings,
 10. Configuration: NEMA 5-20R,
 11. Standards: UL 498, 514A, 943; NEMA WD-1, WD-6.
- B. Non-architecturally Finished Areas:
 1. Coverplate: Zinc plated malleable iron or galvanized steel. Single or multiple gang as required.
- C. Corrosive Areas:
 1. Coverplate: Weather resistant zinc plated or aluminum, gasketed, self-closing cover using stainless steel spring.
- D. Exterior Locations:
 1. Coverplate: Weatherproof (NEMA 3R), gasketed, copper-fire aluminum, 2.5 IN minimum cover depth.
- E. Highly Corrosive Areas: Chemical Feed Area

1. Corrosion resistant nickel plated metal parts.
 2. Receptacle body color: Yellow.
 3. Coverplate: Weather resistant zinc plated or aluminum, gasketed, self-closing cover using stainless steel spring.
- F. Hazardous Areas:
1. Rated for Class I, Division 1 and 2, Groups B, C, and D; and Class II, Division 1 and 2, Groups F and G.
 2. Factory-sealed receptacle/switch/coverplate. Zinc plated malleable iron or copper free aluminum with stainless steel screws and gasketed spring-loaded cover.
 3. "Dead-front" construction requiring plug to be inserted and rotated to activate receptacle. Ordinary non-hazardous plug shall not activate the receptacle.
 4. Standard: UL 1010.
- G. Special Purpose Receptacles:
1. NEMA configuration as indicated on the Drawings.
 2. Coverplate: See requirements per area designations herein.
- 2.05 HEAT DETECTOR
- A. Heat detectors shall be combination rate of rise / temperature; 190 deg. F, 120V power with a N.C. contact. Heat detectors shall be Edwards #282B-PL or approved equal.
- 2.06 DOOR SWITCH
- A. Provide door security switches at locations indicated on the plan drawings. Switches shall be magnetic type with contacts normally open held closed when door is closed. Switches shall have anodized finish and be furnished with 3-foot stainless steel armored cable. Door switches shall be Sentrol 2500 series, or approved equal.
- 3.00 EXECUTION
- 3.01 INSTALLATION:
- A. Mount devices where indicated on the Drawings and as scheduled in Section 26 60 00.
 - B. Surface mount receptacles and light switches in concrete construction.
 - C. In masonry and metal stud construction, recess mount receptacles and light switches unless device precludes recessed mounting or unless otherwise noted on the Drawings
 - D. Where more than one receptacle is installed in a room, they shall be symmetrically arranged.
 - E. Set switches and receptacles plumb and vertical to the floor.
- 3.02 IDENTIFICATION:
- A. Refer to Section 26 60 02 for wiring device identification requirements.

3.03 TESTING:

- A. Prior to energization, check for continuity of circuits, for short circuits and check grounding connections. After energization, check each and every wiring device to demonstrate proper operation and receptacle polarization.

END OF SECTION

1.00 GENERAL

1.01 SECTION INCLUDES:

A. Material and installation requirements for:

1. Fuses
2. Circuit Breakers

1.02 DESCRIPTION OF WORK:

- A. This section covers furnishing and installing the furnishing and installation of all fuses and circuit breakers used in this project.

1.03 RELATED SECTIONS:

A. Related Sections include but are not necessarily limited to:

1. Section 26 60 00 – Electrical General Provisions
2. Section 26 60 02 – Basic Materials and Methods
3. Section 26 24 13 - Switchboards
4. Section 26 24 16 – Panelboards
5. Section 26 32 13 – Power Generation
6. Section 26 90 10 – Variable Frequency Drives
7. Section 26 90 17 – Solid State Starter Equipment
8. Section 26 90 20 – Motor Control Centers
9. Section 26 90 21 – Control System
10. Section 26 90 22 – Pump Control Panel

1.04 STANDARDS AND REFERENCES:

- A. All materials and equipment specified herein shall, within the scope of UL Examination Services, be approved by the Underwriter's Laboratories for the purpose for which they are used and shall bear the UL label.

- B. Products shall be designed, manufactured, tested, and installed in compliance with the following standards:

1. American National Standards Institute:
 - a. ANSI/UL 198E Class R Fuses.
 - b. ANSI/UL 198C High-interrupting-Capacity Fuses, Current-Limiting types, Class L.

- C. All materials and equipment specified herein and their installation methods shall conform to the latest published version of the National Electrical Code, NEC.

1.05 SUBMITTALS:

A. Shop Drawings

1. See Section 26 60 00.

1.06 DELIVERY, STORAGE, AND HANDLING:

- A. See Section 26 60 00.

2.00 PRODUCTS

2.01 FUSES:

- A. Fuses shall be of the type and amperage indicated on the drawings. The voltage rating shall be appropriate for the application indicated. The fuse types indicated on the drawings imply a certain set of fuse characteristics. No substitutions of fuse types will be allowed without written approval from the Engineer.

- B. All fuses used on the project shall be provided with “blown fuse” indicators.

- C. Where fuses in motor circuits are indicated but not sized, provide Manufacturer's recommended fuse size based on actual motor installed.

- D. Provide in-line or integrally-mounted fuse clips on control power or low-voltage transformer.

- E. Provide fuse puller or pullers for fuse sizes used.

- F. Provide a minimum of two (2) spare fuses for each fuse used.

- G. Acceptable Manufacturers:

1. BUSSMAN
2. GOULD SHAWMUT
3. LITTLEFUSE
4. RELIANCE

2.02 250/600 VOLT CURRENT-LIMITING FUSES:

- A. General: Provide 300,000 amperes interrupting capacity (AIC) current-limiting fuses of the current ratings shown and with a voltage rating equal to or greater than the voltage at the point of application.

- B. Types:

1. Fuses in circuits supplying individual motors, groups of motors or loads including motors, 600 amperes or less, shall be UL Class RK1 true dual-element, time-delay fuses, unless otherwise shown. Dual-element fuses must hold 500% of rated current for a minimum of 10 seconds and clear 20 times rated current in 0.01 seconds or less.
2. Fuses in circuits supplying individual motors, groups of motors or loads including motors, 601 to 4000 amperes, shall be UL Class L time-delay fuses, unless otherwise

shown. Time delay fuses shall hold 50% of rated current for 4 seconds and clear 20 times rated current in 0.01 seconds or less.

2.03 MOLDED CASE CIRCUIT BREAKERS:

- A. Molded case circuit breakers shall be quick-make and quick-break type. They shall have wiping type contacts. Each shall be provided with arc chutes and individual trip mechanisms on each pole consisting of both thermal and magnetic trip elements. Two and three pole breakers shall be common trip. Circuit breakers utilizing handle ties shall not be allowed. All breakers shall be calibrated for operation in an ambient temperature of 40°C. Molded case circuit breakers shall be trip-free. Each breaker shall have trip indication independent of the ON or OFF positions.
- B. Breakers shall have lugs UL listed for both copper and aluminum.
- C. Circuit breakers shall be capable of accepting the cable shown on the drawings. Circuit breakers not capable of accepting the cable shown shall not be acceptable.
- D. Breakers shall have the interrupting rating and trip rating indicated on the drawings.
- E. Circuit breakers 250-ampere frame and below shall be Cutler-Hammer type Westinghouse Series C with thermal-magnetic trip units and inverse time-current characteristics. A push-to-trip button on the front of the circuit breaker shall provide a local manual means to exercise the trip mechanism.
- F. Circuit breakers 400-ampere through 1200-ampere frame shall be Cutler-Hammer type Westinghouse Series C with microprocessor based RMS sensing trip units. A push-to-trip button on the front of the circuit breaker shall provide a local manual means to exercise the trip mechanism.

2.04 USES:

- A. Breakers covered under this specification may be installed in switchboards, panelboards, motor control centers, combination motor starters, and individual enclosures.

2.05 ENCLOSURES:

- A. Unless otherwise shown on the drawings, enclosures for protective devices shall be NEMA rated for the environment in which they are installed. In general, devices installed in Non-Architecturally Finished areas shall be in NEMA 12 enclosures, devices installed in all other areas shall be in NEMA 4X enclosures.

3.00 EXECUTION

3.01 INSTALLATION:

- A. Fuses and circuit breakers shall be installed in their respective enclosures and locations in such a manner as to insure tight connections so as to preclude arcing and overheating.
- B. Install fuses in fuse holders immediately prior to energization of the circuit in which the fuses are installed. Fuses shall not be installed and shipped with equipment.
- C. Labels

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1. Place fuse identification labels, showing fuse size and type installed, inside the cover of each switch or other location where fuses are installed.

****END OF SECTION****

1.00 GENERAL

1.01 SECTION INCLUDES:

A. Material and installation requirements for:

1. Fused and unfused safety and disconnect switches.

1.02 DESCRIPTION OF WORK:

A. Provide safety and disconnect switch work as shown, scheduled, indicated, and as specified. The types of safety and disconnect switches required for the project include, but are not limited to, equipment disconnects and motor-circuit disconnects.

1.03 RELATED SECTIONS:

A. Related Sections include but are not necessarily limited to:

1. Section 26 60 00 – Electrical General Provisions
2. Section 26 60 02 – Basic Materials and Methods
3. Section 26 05 19 – Wire and Cable
4. Section 26 05 26 – Grounding
5. Section 26 05 33 – Raceways
6. Section 26 27 13 – Service and Metering
7. All Division 23 Sections

1.04 STANDARDS AND REFERENCES:

A. All materials and equipment specified herein shall, within the scope of UL Examination Services, be approved by the Underwriter's Laboratories for the purpose for which they are used and shall bear the UL label.

B. Products shall be designed, manufactured, tested, and installed in compliance with the following standards:

1. National Electrical Manufacturers Association (NEMA):
 - a. NEMA KS 1 Enclosed Switches.
2. Federal Spec. W-S-865 Switch, Box (Enclosed), Surface-Mounted.

C. All materials and equipment specified herein and their installation methods shall conform to the latest published version of the National Electrical Code, NEC.

1.05 SUBMITTALS:

A. Shop Drawings

1. See Section 26 60 00.

2. Cut sheets of the safety and disconnect switches with ratings, voltage, poles, capacity, horsepower, short circuit rating, and all associated accessories clearly indicated.
3. Include dimensioned drawings of electrical safety and disconnect switches which have a rating of 100 amperes or larger, showing the accurately scaled switches, their layout, and relation to associated equipment.

1.06 DELIVERY, STORAGE, AND HANDLING:

- A. See Section 26 60 00.

2.00 PRODUCTS

2.01 DISCONNECTS:

- A. Provide products complying with these specifications and produced by one of the following:
 1. General Electric Company
 2. Square D Company
 3. Siemens
- B. Safety and disconnect switches must have Underwriters' Laboratories, Inc., approval and bear the UL label.

2.02 MATERIAL:

- A. Provide heavy-duty type, dead front, sheet steel-enclosed, surface-mounted safety switches of the type and size indicated. Safety switches shall be rated for the voltage of the circuit in which they are installed. Safety switches used as motor disconnects shall be horsepower rated for the motor served.
- B. Safety switches shall be quick-make break type with permanently attached arc suppressors and constructed such that switchblades are visible in the "OFF" position with the door open. The operating handle shall be an integral part of the box, not of the cover. Switch shall have provision to padlock in the "OFF" position. Safety switches shall have a cover interlock to prevent unauthorized opening of the switch door when the switch mechanism is in the "ON" position or closing of the switch mechanism when the switch door is open.
- C. Cover interlock shall have an override mechanism to permit switch inspection by authorized personnel. Lugs shall be copper-plated or aluminum, suitable for copper or aluminum cable and front removable.

2.03 FUSING:

- A. Provide fusible safety switches where indicated. Fuse clips shall be positive pressure rejection type fuse clips suitable for use with UL Class R fuses. Bussman LPN, RK, LPS.

2.04 NEUTRAL:

- A. Provide safety switches with number of switched poles as indicated. Where a neutral is present in the circuit, provide a solid neutral with the safety switch.

2.05 ENCLOSURES:

- A. Safety switches installed in Non-Architecturally Finished Areas shall be NEMA 1 general-purpose enclosures unless otherwise shown or specified.
- B. Safety switches installed in exterior locations or where exposed to outdoor conditions shall be NEMA 3R (water resistant) unless otherwise shown or specified.
- C. Safety switches installed in wet or corrosive areas shall be NEMA 4X, aluminum or stainless steel, unless otherwise shown or specified.

3.00 EXECUTION

3.01 INSPECTION:

- A. Installer shall examine the areas and conditions under which safety and disconnect switches are to be installed and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION OF SAFETY AND DISCONNECT SWITCHES:

- A. Install safety and disconnect switches where shown, in accordance with the manufacturer's written instruction, the applicable requirements of the NEC, the NECAs "Standard of Installation", and recognized industry practices to ensure that products serve the intended function.
- B. Provide safety switches where shown and at each motor which is out-of-sight-of or greater than 50' from the switch or panel from which the motor circuit is fed, unless another NEC complying disconnecting method is utilized.
- C. Provide all safety and disconnect switches with galvanized angle or other suitable supports where mounting on wall or other rigid surface is impractical. Switches shall not be supported by conduit alone. Where safety and disconnect switches are mounted on equipment served, the switch shall not inhibit removal of any service panels or interfere with any required access areas.
- D. Fasten securely to supporting structure at walls and stands:
 - 1. Wood screws or lag screws to wood boards or timbers,
 - 2. Machine bolt to metal framing or plates,
 - 3. Expansion anchors to concrete walls,
 - 4. Expansion toggle wing bolts or sleeve anchors to hollow block,
 - 5. Provide 1 inch spacers to set panel out from concrete or block wall.
- E. Stands and supports:
 - 1. Corrosion-resistant materials and finishes,
 - 2. Unistrut-type materials for fabrication,
 - 3. Expansion anchors for bolts in concrete floor,
 - 4. Machine bolt to metal framing or plates,

5. Wood screws or lag screws to wood boards or timber,
 6. Backing plate for mounting units,
 7. Fasten stand securely to floor,
 8. Dimensions as required by equipment to be mounted.
- F. Arrange for driven equipment use or function:
1. Similar units adjacent.
 2. Adequate space for operation and servicing.
- G. Mounting height:
1. Single unit, 4 feet 6 inch center line above floor
- H. Install disconnect switches used with motor-driven appliances, motors, and controllers within sight of the controller position unless otherwise indicated.
- I. Coordinate safety and disconnect switch installation work with electrical raceway and cable work as necessary for proper interface.
- 3.03 TESTING:
- A. Prior to energization, check for continuity of circuits and for short circuits.
- 3.04 IDENTIFICATION:
- A. Refer to Section 26 60 02, “Basic Materials and Methods”, for applicable painting, nameplates, and labeling requirements.

****END OF SECTION****

1.00 GENERAL

1.01 SECTION INCLUDES:

A. Material and installation requirements for:

1. General interior lighting
2. Outdoor area lighting
3. Emergency and egress lighting

1.02 DESCRIPTION OF WORK:

- A. The extent of lighting work is as shown and scheduled on the drawings, and as indicated by the requirements of this Section. The Contractor shall furnish all materials, accessories, and any other equipment necessary for the complete and proper installation of all lighting fixtures included in this Contract.
- B. The types of lighting fixtures required for the project may include, but are not limited to:
1. LED fixtures,
- C. Specifications and scale drawings are intended to convey the salient features, function and character of the fixtures only, and do not undertake to illustrate or set forth every item or detail necessary for the work.
- D. Minor details, not usually indicated on the Drawings nor specified, but that are necessary for the proper execution and completion of the fixtures shall be included, the same as if they were herein specified or indicated on the Drawings.
- E. The Owner shall not be held responsible for the omission or absence of any detail, construction feature, etc. that may be required in the production of the fixtures. The responsibility of accurately fabricating the fixtures to the fulfillment of this specification rests with the Contractor.

1.03 RELATED SECTIONS:

A. Related Sections include but are not necessarily limited to:

1. Section 26 60 00 - Electrical General Provisions.
2. Section 26 05 33 - Raceways and Boxes.
3. Section 26 27 26 – Wiring Devices.

1.04 STANDARDS AND REFERENCES

- A. All materials and equipment specified herein shall within the scope of UL Examination Services, be approved by the Underwriter's Laboratories for the purpose for which they are used and shall bear the UL label.
- B. Products shall be designed, manufactured, tested, and installed in compliance with the following standards:
1. National Electrical Manufacturers Association (NEMA):

- a. NEMA WD-1, General Purpose Wiring Devices.
- b. ANSI/NEMA/ANSLG C78.377-2008 – American National Standard for the Chromaticity of Solid-State Lighting Products
2. National Fire Protection Association (NFPA):
 - a. Code for Safety to Life from Fire in Buildings and Structures.
3. American National Standards Institute:
 - a. C82.SSL1 – SSL Drivers (in ANSI development)
4. American Society for Testing and Materials International (ASTM)
 - a. B117-09 – Standard Practice for Operating Salt Spray (Fog) Apparatus
5. Illuminating Engineering Society of North America (IESNA)
 - a. DG-13-98 – Guide for the Selection of Photocontrols for Outdoor Lighting Applications
 - b. HB-10-11 – IES Lighting Handbook, 10th Edition
 - c. LM-64-01 – Photometric Measurements of Parking Areas
 - d. LM-69-95 (R2002) – Interpretation of Roadway Luminaire Photometric Reports
 - e. LM-79-08 – IESNA Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products
 - f. LM-80-08 – IESNA Approved Method for Measuring Lumen Maintenance of LED Light Sources
 - g. RP-16-10 – ANSI/IES Nomenclature and Definitions for Illuminating Engineering
 - h. RP-33-99 – Recommended Practice for Lighting for Exterior Environments
 - i. TM-15-11 – Luminaire Classification System for Outdoor Luminaires
 - j. TM-21-11 – Projecting Long Term Lumen Maintenance of LED Light Sources
6. Underwriters Laboratories (UL)
 - a. 1449 – Light-Emitting Diode (LED) Equipment for Use in Lighting Products
- C. All materials and equipment specified herein and their installation methods shall conform to the latest published version of the National Electrical Code, NEC.

1.05 DEFINITIONS:

- A. Lighting terminology used herein is defined in IES RP-16. See referenced documents for additional definitions.
 1. Exception: The term “driver” is used herein to broadly cover both drivers and power supplies, where applicable.

2. Clarification: The term “LED light source(s)” is used herein in accordance with IES LM-80 to broadly cover LED package(s), module(s), and array(s).

1.06 SUBMITTALS:

A. Shop Drawings

1. See Section 26 60 00.

1.07 DELIVERY, STORAGE, AND HANDLING:

A. See Section 26 60 00.

- B. Deliver lighting fixtures individually wrapped in factory-fabricated fiberboard type containers.
- C. Handle lighting fixtures carefully to prevent breakage, denting, and scoring the fixture finish. Do not install damaged lighting fixtures.
- D. Store lighting fixtures in a clean, dry space and protect from the weather.

1.08 WARRANTY:

A. Standard Warranty

1. Provide a written 5-year on-site replacement material, fixture finish, and workmanship. On-site replacement includes transportation, removal, and installation of new product. Finish warranty must include warranty against failure or substantial deterioration such as blistering, cracking, peeling, chalking, or fading.
2. Provide a written 5-year replacement material warranty for defective or non-starting LED source assemblies.
3. Provide a written 5-year replacement material warranty on all power supply units (PSU).
4. Provide a written 5-year replacement warranty for luminaires producing inadequately maintained illuminance levels at end of warranty period, as prorated from levels expected at end of useful life.
5. Owner may request an optional 10-year replacement warranty for inadequately maintained illuminance levels, finish of luminaire, PSU, or defective LED source assemblies. The terms of the extended warranty will be negotiated by the Site Owner and the luminaire manufacturer for an additional cost.
6. Warranty period must begin on date of possession. The supplier will provide the Site Owner with appropriate signed warranty certificates. The Site Owner must receive certificates prior to final payment.

2.00 PRODUCTS

2.01 LUMINAIRE REQUIREMENTS:

A. General Requirements

1. Luminaires must be of the types and manufacturers described in the LUMINAIRE REQUIREMENTS section, with light source, wattage and voltage as indicated on

Drawings. Specific manufacturer and model number references are indicated as a standard of performance and quality. Other manufacturers' models may be supplied provided the product meets or exceeds the specifications. The alternate fixtures must achieve the same photometric levels and uniformity ratios.

2. All housing finishes must be baked-on enamel, anodized, or powder-coated, unless otherwise specified in subsection below.
 3. Luminaire shall have an external label per ANSI C136.15.
 4. Luminaire shall have an internal label per ANSI C136.22.
 5. The luminaire must be subjected to 100,000 cycles of 2 Gs at the resonant frequency of the luminaire (between 5 and 30 Hz) applied at the center of gravity of the luminaire on three primary axes per ANSI C136.31 without damage to the luminaire. The luminaire must be fully functional upon completing the test.
 6. Luminaire must be UL-listed for wet locations and wiring cavity must be field accessible for service or repair needs.
 7. Optical cavity must be a minimum IEC 60529/IP65.
 8. Fully assemble and electrically test luminaires before shipment from factory.
 9. The coating must be capable of surviving ASTM B117 Salt Fog environment for 500 hr minimum without blistering or peeling. The coating must demonstrate gloss retention of greater than or equal to 90% for 500 hr exposure QUV test per ASTM G53 UVB313, 4 hr UV-B 60°C/4 hr condensation 50°C.
 10. Luminaire must be rated for -20°C to +40°C operation.
 11. Luminaire arm bolts must be 304 stainless steel or zinc-plated steel and Grade 8.
 12. Luminaire must have locality-appropriate governing mark and certification.
 13. Color of the luminaire must be as specified.
- B. Drivers must meet the following requirements:
1. Must have a minimum efficiency of 85%.
 2. Rated case temperature shall be suitable for operation in the luminaire operating in the ambient temperatures.
 3. Input Voltage: capable of 120 to 480 (±10%) volt, single phase as required by the site.
 4. Power supplies can be UL Class I or II output.
 5. Operating frequency must be 50/60 Hz.
 6. Drivers must be Reduction of Hazardous Substances (RoHS) compliant (see <http://www.rohs.eu/english/index.html>).

7. Minimum time between failures (MBTF = total hours of testing / number of failures) shall be greater than 300,000 hours at full load and 25°C ambient, in accordance with MIL-HDBK-217.
 8. Lifetime = 500,000 hours at full load and 25°C ambient.
- C. Electromagnetic Interference
1. Shall have a maximum total harmonic distortion (THD) of: = 20% at full input power and across specified voltage range.
 2. Shall comply with FCC 47 CFR part 15 non-consumer radio frequency interference/electromagnetic interference standards.
- D. Electrical Safety Testing
1. Luminaire shall be listed for wet locations by an OSHA NRTL.
 2. Luminaires shall have locality-appropriate governing mark and certification.
- 2.02 CONTROL REQUIREMENTS:
- A. Optional Controls: Optional controls installed in addition to the primary control system may include but are not limited to:
1. After hours dimming control – dims light levels to X% [Site Owner must specify between 10% - 50% of full lumen output] after expected building activity ends
 2. After hours switching control – turns off or reduces light levels after expected building activity ends
 - a. Specific areas turned off after expected building activity ends.
 - b. Overall reduction of light level after building activity ends.
 3. Lumen maintenance – Luminaires are initially dimmed to 70% of full output, with input power then gradually (and automatically) increased over time to compensate for LLD.
 4. Occupancy Sensor Controls
 - a. Install and aim sensors in locations to achieve coverage of areas indicated. Coverage patterns shall be derated as recommended by manufacturer based on mounting height of sensor and tree locations. Do not simply use gross rated coverage in manufacturer's product literature.
 - b. Occupancy/vacancy sensors shall comply with NEMA Standard WD 7-2000, which provides for testing requirements on the issues of performance sensitivity.
 - c. Infrared: Integral to the luminaire. Detect occupancy by changed in infrared energy within a coverage area and must be capable of operating between -20°C to +40°C and be wet-location rated.
 - d. Sensors shall be located or shielded or controlled by software to adjust sensitivity based on ambient temperature or air temperature variations.

- e. Sensor must incorporate a failsafe feature such that lamps fail “on” in the event of sensor failure.
 - f. If sensors are to be installed integral to the luminaire, installation must be performed by luminaire manufacturer.
5. End-of-Life
- a. Provide end-of-life mechanism into the luminaire. When the LED die output has reached end of useful life, the luminaire should enter a visible “failure mode” (e.g., intermittent flashing or flickering).
- 2.03 PRODUCT MANUFACTURERS:
- A. Substitution Limitations: Any manufacturer who offers products that comply with the required product performance and operation criteria may be considered.
 - B. Product Options
 - 1. The above product description, performance and operation requirements must be followed.
 - 2. Other mutually exclusive product options offered by qualified manufacturers such as housing color or lamp type are to be determined by the customer/project manager prior to selection and installation of the product.
- 2.04 MATERIALS AND COMPONENTS:
- A. Provide lighting fixtures, of the size, type, and rating indicated on the Luminaire Schedule; complete with, but not limited to, lamps, lamp holders, reflectors, diffusers, louvers, wire guards, tube guards, ballasts, fuses, starters, and wiring. Fixtures shall be furnished with all required accessories, including mounting hardware and hold-down clips as required for complete installation in the ceiling type shown on the drawings.
 - 1. Lighting equipment shall be complete, wired, and including supporting means, such as plaster frames, supports, hangers, holders; current or voltage modifiers, such as ballasts, starters; light control materials; specifically diffusers, louvers, lenses, reflectors and refractors; and lamps.
 - 2. Lighting fixtures shall be designed for highest relative efficiency and service. Maintenance to be simple and re-lamping possible without use of special tools.
 - 3. Lighting fixtures shall be constructed and installed in accordance with local building codes and shall bear label of approved testing agent. Materials shall be new and of the best grade of approved manufacturing standards. Workmanship shall be of highest order.
 - 4. Ferrous fixture components shall receive treating to assure corrosion resistance and paint adherence. Aluminum parts, unless made of alloys having inherent corrosion resistance shall be anodized or coated with oxidation-preventing treatment. Finish shall be baked enamel where color is indicated.
 - 5. Plastic shall be 100% virgin acrylic.
 - B. General Fixture Construction:

1. All materials, accessories, and other related fixture parts shall be new and free from defects which in any manner may impair their character, appearance, strength, durability and function, and protected from any damage or injury from the time of fabrication to the time of delivery and until final acceptance of the work.
2. Housings shall be so constructed that all electrical components are easily accessible and replaceable without removing fixtures from their mountings or disassembly of adjacent construction.
3. All fixtures shall be completely wired at the factory.
4. Fixtures for use outdoors or in areas designated as wet locations shall be suitably gasketed to prevent the entrance of moisture. Provide approved wire mesh screens for ventilation openings. Damp location fixtures to be of corrosion resistant parts and hardware.
5. In application and mounting condition specified, fixtures and ballasts must operate within the temperature limits of their design and as specified by Underwriters' Laboratories, Inc.

C. Lenses:

1. Plastic for lenses and diffusers shall be formed of colorless 100% virgin acrylic. Acrylic plastic lenses and diffusers shall be properly cast, molded or extruded as specified, and shall remain free of any dimensional instability, discoloration, embrittlement, or loss of light transmittance or at least 15 years.
2. Glass used for lenses, refractors, and diffusers in incandescent and HID lighting fixtures shall be tempered for impact and heat resistance; the glass shall be crystal clear with a transmittance of not less than 88%.
3. All lenses, louvers, or other light diffusing elements shall be removable, but positively held so that hinging or other normal motion will not cause them to drop out.
4. All lenses shall be clean and free of dust at the time of substantial completion.

D. Finishes

1. Painted Surfaces: Synthetic enamel with acrylic, alkyd, epoxy, polyester, or polyurethane base. Light stabilized, bake on at 350 degrees Fahrenheit minimum, catalytically or photo-chemically polymerized after application.
2. White Finishes: Minimum of 85% reflectance.
3. Frames: Ceiling opening frames shall either be manufactured of nonferrous metal, or be suitably rustproof after fabrication.
4. Undercoat: Except for stainless steel, provide ferrous metal surfaces with a five-stage phosphate treatment or other acceptable base bonding treatment before final painting and after fabrication.
5. Unpainted Surfaces: Unpainted non-reflecting surfaces shall be satin-finished and coated with a baked-on clear lacquer to preserve the surface. Where aluminum surfaces are treated with an anodic process, the clear lacquer coating may be omitted.

- E. Wiring:
1. Generally use SF-2 insulated wire for rewiring existing or new wire at replicated light fixture. SF-1 may be substituted in those locations where space will not permit the installation of SF-2 and where the load is 6 amps or less. Provide 600-volt insulation.
 2. Factory-wire all fixtures. Provide leads no shorter than 1'0" or as required to suit the project application.

2.05 LED FIXTURES:

- A. Provide LED fixtures as scheduled on the Drawings, complete with fuse ballast, lamps of the type, color, wattage, and size scheduled, or as specified by the lighting fixture manufacturer.

2.06 EXIT SIGNS

- A. Provide exit signs as scheduled on the Drawings. Exit lighting fixtures shall meet the requirements of all applicable federal, state, and local codes.
- B. Exit signs shall have provisions for flashing upon loss of power or flashing upon a signal from the building fire alarm system, where specified, scheduled, or noted on the Drawings.
- C. Exit sign battery packs shall meet all specified requirements for LED emergency battery backup units.

2.07 POLE-MOUNTED LIGHTING FIXTURES:

- A. Provide pole mounted lighting fixtures and poles of the types scheduled on the Drawings. Fixture manufacturers shall be as scheduled on the Drawings. Fixtures shall be furnished with all required accessories and trim as required for a complete installation.
- B. Fixtures shall be supplied with all fixture couplings and/or other accessories required by the manufacturer for proper installation to the pole.

3.00 EXECUTION

3.01 INSTALLATION:

- A. General: Install lighting fixtures of the types indicated, where shown, and at the indicated heights in accordance with the fixture manufacturer's written instruction and recognized industry practices to ensure that the fixtures comply with the requirements and serve the intended purposes. Do not scale drawings for exact location of the lighting fixtures.
- B. Standards: Comply with NEMA standards, applicable requirements of the NEC pertaining to installation of interior lighting fixtures, and with applicable portions of the NEMA "Standard of Installation".
- C. Mounting: Fasten fixtures securely to the indicated structural support members of the building. Provide separate supports or mounting clips for all recessed ceiling-mounted lighting fixtures in accordance with the NEC. Check to ensure that solid pendant fixtures are plumb.
- D. Appurtenances: Install each fixture properly and safely. Furnish and erect hangers, rods, mounting brackets, supports, frames, and other equipment required.

- E. Coordination: Furnish lighting fixtures complete with appurtenances required for the proper, safe, and distortion-free installation in the various surfaces in which they appear. Determine surface types from the drawings.
 - F. Continuous Row Fixtures: Rigidly align all continuous rows of lighting fixtures for true in-line appearance.
 - G. Pendant Fixtures: Install pendant lighting fixture plumb and at a height above the finished floor as specified in the drawings. Use ball aligners and canopies on pendant fixtures unless noted otherwise.
 - H. Outlet Boxes: The locations indicated for outlet boxes of lighting fixtures are diagrammatic. Outlets shall be located as required, to coincide with suspension hangers, where they occur, and with structural and architectural elements of the building.
 - I. Installation Sequence: Do not install fixtures or such parts as finishing plates and trims for recessed fixtures until all plastering and painting that may mar fixture finishes has been completed. Install reflector cones, baffles, aperture plates, light controlling elements for air handling fixtures, and decorative elements after completion of ceiling tiles, painting, and general cleanup.
 - J. Concealment: Whenever a fixture or its hanger canopy is applied to a surface mounted outlet box, a finishing ring shall be utilized as necessary to conceal the outlet box.
 - K. LED Lighting Fixtures Installed in UL-rated Ceiling Assemblies: Fixtures shall have armored cable or flexible metallic conduit fixture-tails used for connection of lighting fixtures and shall have wiring installed as follows:
 - 1. Shall be wired through the ends of the fixtures, or shall be provided with 90 degree ells on top of the fixtures, to allow the installation of the UL-approved fire-rated covers by the Ceiling Contractor.
 - 2. Failure to provide the required connectors shall not relieve this Contractor of his responsibility for replacing the connectors at no additional cost to the Owner.
 - 3. The UL fire-rated covers shall not be notched by the Ceiling Contractor because of improper connectors installed on the fixtures by this Contractor.
 - 4. This Contractor shall verify with the Engineer and the Ceiling Contractor, that specific requirements have been met for the type of UL-rated ceiling assembly being installed.
 - L. Cleanup: At the time of final acceptance by the Owner, all lighting fixtures shall have been thoroughly cleaned with materials and methods recommended by the manufacturers, all broken parts shall have been replaced, and all lamps shall be operative. Replace blemished, damaged, or unsatisfactory fixtures as directed by the Engineer.
- 3.02 TESTING:
- A. General: Upon completion of installation of lighting fixtures and after building circuitry has been energized, apply electrical energy to demonstrate proper operation of lighting fixtures and controls. When possible, correct malfunctioning units at the site, then retest to demonstrate proper operation; otherwise, remove and replace with new units and proceed with retesting.

- B. Pre-inspection Tasks: Immediately before final inspection, thoroughly clean all fixtures inside and out, including plastics and glassware, adjust all trim to properly fit adjacent surfaces, replace broken or damaged parts and lamp, and test all fixtures for electrical and mechanical operation. Any fixtures or parts of fixtures, which have begun to show signs of rust or corrosion at the time of completion of the job, shall be removed and replaced with properly protected metal parts.

END OF SECTION

1.00 GENERAL

1.01 SECTION INCLUDES:

- A. Contract requirements
- B. Codes, permits and fees
- C. Quality assurance and standards
- D. Site visit and familiarization
- E. Submittals
- F. Coordination of electrical work
- G. Material and workmanship
- H. Space requirements
- I. Safety regulations
- J. Delivery, storage and handling of materials

1.02 RELATED SECTIONS:

- A. Related Sections include but are not necessarily limited to:
 - 1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
 - 2. Division 1 - General Requirements.

1.03 STANDARDS AND REFERENCES:

- A. Refer to Division 1 for general administrative/procedural requirements related to compliance with applicable standards.
- B. This Work and all materials shall meet the standards set forth in the applicable portions of the following recognized standards:
 - 1. ANSI – American National Standards Institute.
 - 2. ASHRAE – American Society of Heating Refrigerating & Air-Conditioning Engineers.
 - 3. ASME – American Society of Mechanical Engineers.
 - 4. ASPE – American Society of Plumbing Engineers.
 - 5. ASTM – American Society for Testing and Materials.
 - 6. CBM – Certified Ballast Manufacturers.
 - 7. ETL – Electrical Testing Laboratory.
 - 8. FM – Factory Mutual Engineering Corporation.
 - 9. IEEE – Institute of Electrical and Electronics Engineers.
 - 10. IES – Illuminating Engineering Society of North America.

11. NEC – National Electric Code (by NFPA).
12. NEMA – National Electrical Manufacturers Association.
13. NFPA – National Fire Protection Association.
14. UL – Underwriters’ Laboratories Inc.

1.04 SUBMITTALS:

A. General: Submittals required for this project shall include, but are not be limited to:

1. Shop Drawings and Product Brochure Submittals.
2. Record (as-installed) Drawings.
3. Certifications and Test Reports.
4. Operating and Maintenance Manuals.
5. Warranties (Guarantees).
6. Refer to Division 1 for additional submittal requirements.

B. Shop Drawings and Product Brochure Submittals:

1. The terms “Submittal” and “Shop Drawing” in this Specification are defined as either product literature, samples of equipment, or actual Shop Drawings.
2. The Contractor shall submit a minimum of six (6) complete bound sets of Shop Drawings and complete data covering each item or equipment or material. The Owner and Engineer will each retain one (1) copy of all Shop Drawing submittals for their files. Where full size Drawings are involved, submit two (2) prints and one (1) reproducible in lieu of six (6) sets.
3. Submittals shall be provided with a cover sheet with the names and addresses of the Project, Engineer, General Contractor, and the Subcontractor making the submittal. The cover sheet shall also contain the Specification section number applicable to the item or items submitted, the item nomenclature and description and a submittal number. Electrical submittals shall be numbered sequentially by Specification section with a sequence suffix (e.g. 26 05 19-1, 26 06 33-2, etc.). Re-submittals shall be numbered with the original submittal number plus an "R" in the sequence suffix (e.g. the re-submittals of submittal 26 05 19-1 would be 26 05 19-1R1, 26 05 19-1R2).
4. Submittals shall be provided with an index page with a listing of all data included in the submittal.
5. Submittals shall be provided with a list of variations, including unfurnished or additional items or features between the submitted equipment and the specified equipment. If there are no variations, then this page shall state "No Variations". Where variations affect the work of other contractors, then the contractor shall certify on this page that these variations have been fully coordinated with the affected contractors and that the submitting contractor shall pay all additional costs to the affected contractors associated with the variations.

6. Submittals shall provide equipment information including manufacturer's name and designation, size, performance and capacity data. All applicable listings, labels, approvals and standards shall be clearly indicated.
 7. Submittals shall provide dimensional data and actual sketches as applicable to show that the submitted equipment will fit the space available with all required Code and maintenance clearances.
 8. Submittals shall include an identification of each item of material or equipment matching that indicated on the Drawings.
 9. Submittals shall provide sufficient pictorial, descriptive and diagrammatic data on each item to show its conformance with the Drawings and Specifications. Any options or special requirements shall be so indicated. All applicable information shall be clearly indicated with arrows or another approved method. Any non-applicable information shall be crossed out.
 10. Submittals shall include additional information as required in other sections of this Division.
 11. Submittals shall include certification by the General Contractor and Subcontractor that the material submitted is in accordance with the Contract Documents signed and dated.
 12. Reports or information requiring certification shall be certified by an authorized officer of the manufacturer or testing agency.
 13. Submittals shall include Certified Shop Drawings showing dimensions, loading details, anchor bolt locations, and inserts required for each piece of equipment set on concrete in sufficient time to cause no delay in the Work.
 14. Equipment and material submittals shall show sufficient data including all performance data, recommended installation details, and sufficient data to indicate complete compliance with the Contract Documents, including proper sizes, clearances, capacities, materials, and finishes.
- C. Required Shop Drawing Submittals:
1. Submittal Shop Drawings, including, but not limited to the following items:
 - a. All products and division specific requested submittal requirements in all division 23, 26 and 40 sections.
 - b. Coordination Drawings as required by this Section.
 - c. As-Built Drawings.
- D. Shop Drawing Submittal Review:
1. Shop Drawings will be reviewed for general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Any action shown in review comments is subject to the requirements of the Contract Documents. The submitting Contractor is responsible for: dimensions that shall be confirmed at the job site; fabrication processes and techniques of construction;

coordination of his work with that of all other trades; and the satisfactory performance of his work.

E. Certifications and Test Reports:

1. The Engineer may, at their discretion, witness any or all on and off site acceptance and operational testing. Submit a detailed listing of certification and testing for each system indicating estimated dates for completion of system installation.
2. Test procedures and test result reporting forms shall be submitted for review no later than the date of the certification and testing listing submittal.
3. Submit four copies (coordinate with commissioning requirements) of all certifications and test reports to the Engineer for review adequately in advance of completion of the Work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.
4. Certifications and test reports to be submitted shall include, but not be limited to those items outlined in Section 26 01 26 - Electrical Testing.
5. Notify the Engineer in writing one week prior to all scheduled testing to allow time for Engineer to schedule witnessing of testing, where elected by the Engineer.

1.05 OPERATING AND MAINTENANCE MANUALS:

- A. Submit two copies of Operating and Maintenance Manuals to the Engineer for approval prior to the beginning of operator training. Provide four approved Operating and Maintenance Manuals for use in operator training. Manuals shall be bound in rigid cover, 3-ring binders with spine and cover labels and shall provide operating and maintenance information for every piece of equipment furnished under this Specification. All sections shall be typed and indexed into sections and labeled for easy reference. Bulletins containing information about equipment that is not installed on the project shall be properly marked up or stripped and reassembled. All pertinent information required by the Owner for proper operation and maintenance of equipment supplied shall be clearly and legibly set forth in memoranda which shall, likewise, be bound with bulletins. As a minimum, the following information shall be provided as applicable:
1. Complete description of each system, item of equipment, and apparatus provided under this Division, including ratings, capacities, performances, data and curves, characteristics identifying name and number, locations, and wiring diagrams, including sources for all parts.
 2. Fully detailed parts lists, including all numbered parts and recommended spare parts, of each item of equipment and apparatus provided under this Division.
 3. Manufacturer's printed instructions describing operation, service, maintenance, and repair of each item of equipment and apparatus.
 4. Typewritten record of tests made of materials, equipment, and systems included under this Division. Such records shall state the dates the tests were conducted, name(s) of person(s) making and witnessing the tests, and citing any unusual conditions relevant to the tests.

5. Identifying names, name tags designations and locations for all equipment.
 6. Fuse and motor heater information including location and use.
 7. Equipment and motor nameplate data.
 8. Copies of all approved Shop Drawing submittals.
 9. Fabrication drawings.
 10. Equipment and device bulletins and cut sheets clearly highlighted to show equipment installed on the project and including performance curves and data as applicable.
 11. Maintenance instructions clearly highlighted to show all required periodic maintenance and lubrication.
 12. Wiring diagrams.
 13. Operating instructions clearly highlighted to show proper operating procedures for all equipment.
 14. Exploded parts views and parts list for all equipment and devices.
 15. Color-coding charts for all painted equipment and conduit.
 16. Location and listing of all spare parts and special keys and tools furnished to the Owner.
- B. Tools: Provide and deliver to the Owner’s authorized representative any special tools required for maintenance of systems, equipment, and apparatus installed under this Division prior to requesting final acceptance of the installation.
- C. Commissioning requirements are part of this contract.
- 1.06 CODES, PERMITS AND FEES:
- A. General:
1. Comply with the most recently revised versions of applicable laws, rules, regulations, and ordinances of federal, state, and local utilities and authorities. Where alterations to and deviations from the Contract Documents are required by said authority, report the requirements and secure approval before starting work. Obtain all applicable permits, licenses and inspections and pay all fees charged by above authorities.
- B. Code Design Basis:
1. The following codes and ordinances were used in the design of the project and shall be complied with during construction of the project.
 - a. Electrical Code – NEC, most recent edition enforced.
 - b. WAC – Washington Administrative Code
 - c. Life Safety Code – NFPA 101
- C. Precedence:

1. Where Contract Document requirements are in excess of Code requirements and are permitted under the Code, the Contract Documents shall govern. None of the terms or provisions of the drawings or specification shall be construed as waiving any of the rules, regulations or requirements of these authorities. In the event of conflict between the Contract Documents and the local enforcing authority, the latter shall rule. Any modifications resulting there from shall be made without additional cost to the Owner or Engineer. This Contractor shall report any such modifications to the Engineer and secure his approval before proceeding.

1.07 QUALITY ASSURANCE:

A. Materials/Methods:

1. Manufacturers, materials and methods described in the various sections of the Specifications, and indicated on the Drawings are intended to establish a standard of quality only. It is not the intention of the Engineer to discriminate against any product, material or method that is equal to the standards as indicated and/or specified, nor is it intended to preclude open, competitive bidding. The fact that a specific manufacturer is listed as an acceptable manufacturer should not be interpreted to mean that the manufacturers standard product would meet the requirements of the project design, Specifications and space constraints.

B. Alternative Products/Materials/Methods:

1. Products by other reliable manufacturers, other materials, and other methods may be accepted provided they have equivalent capacity, construction, and performance. Under no circumstances shall any substitution be made without the prior written approval of the Engineer.
2. Wherever a definite product, material or method is specified and there is not a statement that another product, material or method will be acceptable, it is the intention of the Engineer that the specified product, material or method is the only one that shall be used without prior approval.

C. Alternative Equipment:

1. Where substituted or alternative equipment is used on the project, it shall be the responsibility of the Contractor or Subcontractor involved to verify that the equipment will fit in the space available, including all required Code and maintenance clearances, and to coordinate all equipment requirements and provisions with the Electrical Design and all other Contractors.

D. Compatibility:

1. Provide products that are compatible with other products of the electrical work, and with other work requiring interface with the electrical work, including electrical connections and control devices. For exposed electrical work, coordinate colors and finishes with other work. Determine in advance of purchase that equipment and materials proposed for installation will fit into the confines indicated, leaving adequate clearance as required by applicable codes and for adjustment, repair, and replacement.

1.08 SITE VISIT AND FAMILIARIZATION:

A. General:

1. Become familiar with the Drawings and Specifications, examine the premises, and understand the conditions under which the Contract shall be performed, prior to submitting a bid.

B. Site:

1. Be informed of the site conditions, verify locations of new and existing equipment and determine exact requirements for connections.

C. Coordination:

1. Submission of a bid for this project infers that the Electrical Contractor has visited the site and has become familiar with the Drawings and site conditions and has included in his proposal, all work necessary to properly install the systems on the project.

D. Pre-Bid Conference:

1. Refer to Division 1.

1.09 DRAWINGS AND SPECIFICATIONS:

A. General:

1. The Drawings are schematic in nature and indicate approximate locations of the electrical systems, equipment, fixtures and devices, except where specific locations are noted and dimensioned on the Drawings. All items are shown approximately to scale. The intent is to show how these items shall be integrated into the project site. Locate all items by on the job measurements and in accordance with the Contract Documents. Cooperate with other trades to ensure project completion as indicated.

B. Location:

1. Prior to locating electrical devices, light fixtures, and other items, obtain the Engineer's approval as to exact location. Locations shall not be determined by scaling Drawings. Mount lighting fixtures and electrical devices at the heights directed by the Engineer. Contractor shall be responsible for costs of redoing work of trades necessitated by failure to comply with this requirement.
2. All electrical devices, lighting fixtures, and other devices shall be referenced to coordinated, established data points and shall be located to present symmetrical arrangements with these points and to facilitate the proper arrangements of acoustical tile panels and other similar panels with respect to the mechanical and electrical outlets and devices. Electrical devices, fixtures, and outlets shall be referenced to such features as wall and ceiling furring, balance, border widths, masonry joints, etc. Outlets in acoustical tile shall occur symmetrically in tile joints or in the centers of whole tiles and the exact location of each outlet and the arrangements to be followed shall be acceptable to the Engineer. Outlets in wall tile or masonry construction shall occur symmetrically in the centers of whole tiles, bricks, or blocks and the exact location of each outlet and the arrangement to be followed shall be acceptable to the Engineer.

3. The Drawings show diagrammatically the location of the various outlets and apparatus. Exact locations of these outlets and apparatus shall be determined by reference to the general Drawings and to all detail Drawings, equipment Drawings, rough-in Drawings, etc., by measurements at the building, and in cooperation with the other trades. The Owner and Engineer reserve the right to make any reasonable change in location of any outlet or apparatus before installation, without additional cost to the Owner.

C. Specifications:

1. The Specifications are intended to supplement the Drawings and it is not in the scope of the specifications to mention any part of the work that the Drawings are competent to fully explain. Conversely, any part of the work that the specification is competent to fully explain may not be mentioned on the Drawings.

1.10 DISCREPANCIES:

A. Clarification:

1. Clarification shall be obtained before submitting a proposal for the Work under this Division as to discrepancies or omissions from the Contract Documents or questions as to the intent thereof.

B. Detailed Instructions:

1. Should it appear that the work hereby intended to be done or any of the materials relative thereto is not sufficiently detailed or explained in the Drawings or Specifications, then the Contractor shall apply to the Engineer for such further Drawings or explanations as may be necessary, allowing a 10 working day time period for the Engineer to respond.

C. Interpretations:

1. Should any doubt or question arise respecting the true meaning of Drawings or Specifications, reference shall be made to the Engineer, whose written decision shall be final and conclusive.

D. Contractor Agreement:

1. Consideration will not be granted for misunderstanding of the amount of work to be performed. Submission of a bid conveys full Contractor agreement of the items and conditions specified, shown, scheduled, or required by the nature of the project.

1.11 UTILITIES:

A. General:

1. Utility information shown on the Drawings has been shown based upon data obtained from the site survey and the agencies having jurisdiction and are accurate to the best of the knowledge of the Engineer.

B. Coordination:

1. The Contractor shall be responsible for field verification of the actual location of site and/or building utilities and shall make modifications necessary for connection to or construction around those utilities at no additional cost to the Owner or Engineer.

1.12 TEMPORARY FACILITIES:

A. General:

1. Refer to Uniform General Conditions and Division 1 for requirements concerning temporary electrical facilities.

B. Temporary power, connection and operation of Owner Furnished Equipment:

1. See Scope of Work description under Section 26 60 01.

1.13 SITE OBSERVATION:

A. General:

1. Observations at the site to verify general compliance with Contract Documents shall be made periodically by the Engineer or his representative. Written observation comments shall be submitted to the General Contractor for review and a written response.

1.14 COORDINATION OF ELECTRICAL WORK:

A. General:

1. Refer to Division 1 for general coordination requirements applicable to the entire work.
2. It is recognized that the Contract Documents are diagrammatic in showing certain physical relationships that must be established within the electrical work and in its interface with other work, including utilities and mechanical work, and that such establishment is the exclusive responsibility of the Contractor. The Drawings show diagrammatically the sizes and locations of the various conduit and raceway systems and equipment items along with the sizes of the major interconnecting distribution, without showing exact details as to elevations, offsets, control lines, and installation details.
3. Arrange electrical work in a neat, well organized manner with services running parallel with primary lines of the building construction and with a minimum of 7' overhead clearance where possible.
4. The Contractor shall carefully lay out his work at the site to conform to the structural conditions, to avoid obstructions and to provide proper grading of lines. Exact locations of outlets, apparatus and connections thereto shall be determined by reference to detail Drawings, equipment Drawings, roughing-in Drawings, etc., by measurements at the building and in cooperation with other Contractors and, in all cases, shall be subject to the approval of the Engineer. Relocations necessitated by the conditions at the site or directed by the Engineer shall be made without any additional cost to the Owner or Engineer.
5. All conduit and boxes except those in the various equipment rooms, in unfurnished spaces or where specifically designated herein or on the Drawings shall be run concealed in furring, plenums, and chases. Wherever conditions exist which would cause any of these items to be exposed in finished spaces, the Contractor whose work is involved shall immediately call the situation to the attention of the Engineer and shall stop work in those areas until the Owner's Representative or General Contractor directs the resumption of

the work. Submit for approval a Shop Drawing for any change in equipment placement, etc.

6. Equipment has been chosen to fit within the available space with all required Code and maintenance clearances and shall be installed as shown. Every effort has been made to also accommodate equipment of other approved manufacturers; however, since equipment and access space requirements vary, the final responsibility for installation access and proper fit of substituted equipment rests with the Contractor.
7. System interferences shall be handled by giving precedence to pipe lines that require a stated grade for proper operation. Where space requirements conflict, the following order of precedence shall, in general, be observed:
 - a. Building Lines,
 - b. Structural members,
 - c. Soil and drain piping,
 - d. Utility water piping,
 - e. Electrical conduit.
8. Locate electrical equipment properly to provide easy access. Arrange entire electrical work with adequate code access for operation and maintenance.
9. Advise other trades of openings required in their work for the subsequent move in of large units of electrical work (equipment).
10. Coordinate all items that will affect the installation of the work of this Division. This coordination shall include, but not be limited to: Voltage, ampacity, capacity, electrical connections, space requirements, sequence of construction, building requirements and special conditions.
11. When submitting Shop Drawings on the project, this Contractor is indicating that all necessary coordination has been completed and that the systems, products and equipment submitted can be installed in the building and will operate as specified and intended, in full coordination with all other Contractors and Subcontractors.

1.15 MATERIAL AND WORKMANSHIP:

A. General:

1. Materials and equipment shall be new, of best grade and quality, and standard products of reputable manufacturers regularly engaged in the production of such materials and equipment.

B. Workmanship:

1. Work shall be executed and materials installed in accordance with the best practice of the trades in a thorough, substantial, workmanlike manner by competent workmen, presenting a neat appearance when completed.

C. Manufacturer's Recommendations:

1. With exceptions as specified or indicated on the Drawings or in the Specifications, apply, install, connect, erect, use, clean, and condition manufactured articles, materials, and equipment per manufacturer's current printed recommendations. Copies of such printed recommendations shall be kept at the job site and made available as required.

1.16 SPACE REQUIREMENTS:

A. General:

1. Determine in advance of purchase that the equipment and materials proposed for installation will fit into the confines indicated, leaving adequate code clearances for adjustments, repair, or replacement.

B. Clearance:

1. Allow adequate space for clearance in accordance with requirements of the Code and local inspection department.

C. Scheduled Equipment:

1. The design shown on the Drawings is based on the equipment scheduled.

D. Responsibility:

1. Since space requirements and equipment arrangement vary for each manufacturer, the responsibility for initial access and proper fit rests with the Contractor.

E. Review:

1. Final arrangement of equipment to be installed shall be subject to the Engineer's review.

1.17 SAFETY REGULATIONS:

- A. All electrical work shall be performed in compliance with all applicable and governing safety regulations. All safety lights, guards, signs, and other safety materials and provisions required for the performance of the electrical work shall be provided by and operated by the Electrical contractor.

1.18 DELIVERY, STORAGE AND HANDLING OF MATERIALS:

A. General:

1. Protect all materials and equipment to be installed under this Division from physical and weather damage.

B. Scope:

1. Work under this Division shall include, but not limited to:
 - a. Shipping from point of manufacture to job site,
 - b. Unloading, moving, and storage on site with appropriate protection as required to properly protect equipment from rust, drip, humidity, dust, or physical damage,
 - c. Hoisting and scaffolding of materials and equipment included in this Division,

- d. Ensuring safety of employees, materials, and equipment using such hoisting equipment and scaffolding as is required for safety.

C. Coordination:

- 1. All large pieces of apparatus which are to be installed in the building and which are too large to permit access through doorways, stairways or shafts shall be brought to the job by the Contractor and shall be placed in the spaces before enclosing partitions and structure are completed. All apparatus shall be cribbed up from the floor by Contractor and shall be covered with tarpaulins or other protective covering where required for protection.

1.19 NOISE AND VIBRATION

A. General:

- 1. One year warrants the electrical systems, and their component parts to operate without objectionable noise or vibration. Noise from systems or equipment that results in noise within occupied spaces above the recommended NC curves (refer to ASHRAE Standard) shall be considered objectionable. Vibration shall not be apparent to the senses in occupied areas of the building. Objectionable noise, vibration, or transmission thereof to the building shall be corrected.

1.20 CLEANING, ADJUSTING, AND START-UP:

A. Clean up:

- 1. The Contractor shall clean away from the job site all debris, surplus material, and similar items, resulting from his work or operations, leaving the job and equipment in a clean condition. The Contractor shall thoroughly clean all pieces of equipment, conduit, boxes, fixtures, and similar items, leaving the installation in a first class condition.

B. Start-up Services:

- 1. Where specified for any individual item of electrical equipment, provide a factory-authorized representative for testing, start-up of equipment, and instruction of Owner's operating personnel. Certify that these services have been performed by including a properly executed invoice for these services, or a letter from the manufacturer.

C. Lubrication:

- 1. Provide means for lubricating all bearings and other machine parts. Extend a lubrication tube with suitable fitting to an accessible location and identify it where lubrication fittings are concealed or inaccessible. Lubricate all parts requiring lubrication and keep them adequately lubricated until final acceptance by the Owner.

D. Testing:

- 1. See Section 26 01 26 – Electrical Testing.

E. Operation Prior to Completion:

- 1. When any piece of electrical equipment is operable and it is to the advantage of the Contractor to operate the equipment, he may do so, providing that he properly supervises

the operation, and has the Engineer's written permission to do so. The warranty period shall, however, not commence until such time as the equipment is operated for the beneficial use of the Owner, or date of substantial completion, whichever occurs first. Regardless of whether or not the equipment has or has not been operated, the Contractor shall properly clean the equipment, properly adjust, and complete all deficiency list items before final acceptance by the Owner. The date of final acceptance and the start of the warranty may not be the same date.

1.21 FINAL REVIEW:

A. General:

1. Upon completion of the Work, perform a final test of the entire system.
2. The system shall be operating properly and meet commissioning requirements.
3. After the final test, any changes or corrections noted as necessary for the Work to comply with these Specifications or the Drawings shall be accomplished without delay in order to secure final acceptance of the Work.
4. The date for the final test shall be sufficiently in advance of the Contract completion date to permit execution, before expiration of the Contract, of any adjustments or alterations that the final acceptance tests indicate as necessary for the proper functioning of all equipment. Any such modifications shall be completed within the time allotted for completion of the Contract. Retests shall be conducted as directed and shall be of such time duration as necessary to ensure proper functioning of adjusted and altered items. Retests shall not relieve the Contractor of completion date responsibility.
5. Certificates, including certificates of occupancy from local authorities and documents required herein, shall be completely in order and presented to the Engineer at least one week prior to the review.
6. Individuals knowledgeable of the systems and persons approved by the Engineer shall be present at this final inspection to demonstrate the system and prove the performance of the equipment.

1.22 OPERATION AND MAINTENANCE TRAINING (OWNER INSTRUCTION):

A. General:

1. The Contractor and appropriate factory-trained representatives shall instruct the Owner's representative in the proper operation and maintenance of all electrical and control systems and equipment, and shall explain all warranties.

B. Training Agenda Outline:

1. Prior to instruction of Owner Personnel, the Contractor shall prepare a typed outline, listing the subjects that will be included in this instruction, and shall submit the outline for review by the Engineer at least 2 weeks prior to the time of the training.

C. Training Requirements:

1. Training shall be provided per the specific requirements in other sections of these specifications. In addition to training required in other sections of the specifications, the Contractor shall conduct specifically organized training sessions in the overall operation and maintenance of the electrical and control system for personnel employed by the Owner. The training sessions shall be conducted to educate and train the personnel in operations and maintenance of all components of the electrical system outside the training requirements in the other Sections.
2. Training shall include, but not be limited to, the following:
 - a. Preventative maintenance procedures,
 - b. Trouble-shooting,
 - c. Calibration,
 - d. Testing,
 - e. Replacement of components,
 - f. Equipment operation.
3. At a minimum, one training session, at least 2 hours in duration, shall be conducted at the facility after start-up of the electrical and control systems. The Contractor shall prepare and assemble specific instruction materials for each training session and shall supply such materials to the Owner at least 2 weeks prior to the time of the training.

D. Certification:

1. At the conclusion of the instruction period, the Contractor shall obtain the signature of each person being instructed on each copy of the approved training outline to signify that the personnel has a proper understanding of the operation and maintenance of the systems, and resubmit the signed outlines.

E. Other Requirements:

1. Refer to other Division 26 Sections for additional Operator Training requirements for specific pieces of equipment or specific systems.
2. The Contractor shall coordinate the Operator Training requirements listed above with the Owner Instruction requirements of Division 1.

1.23 CONTRACTOR WARRANTIES AND GUARANTEES

A. General:

1. Contractor shall guarantee all material and equipment installed by him against defects in workmanship and material for a period of 12 months after final acceptance of the work by the Owner. He shall repair or replace any materials or equipment developing such defects within that time promptly on due notice given him by the Owner and at Contractor's sole cost and expense.

B. Equipment:

ELECTRICAL GENERAL PROVISIONS

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1. All equipment bearing a manufacturer's guarantee, such as electrical equipment, devices, components, and similar items, shall be construed to have an extended guarantee to the Owner by the manufacturer. Any such equipment that proves defective in materials or workmanship within the guarantee period is to be replaced by the Contractor in accordance with the manufacturer's guarantee.

2.00 PRODUCTS

2.01 NOT USED.

3.00 EXECUTION

3.01 NOT USED.

****END OF SECTION****

1.00 GENERAL

1.01 SECTION INCLUDES:

- A. Project Description
- B. Electrical Scope of Work
- C. Heat Trace Equipment

1.02 DESCRIPTION OF WORK:

- A. Provide labor, materials, tools, machinery, equipment, fixtures, devices, and services necessary to complete the specified work of this and all other Divisions. Coordinate work with other trades to prevent conflicts without impeding job progress.
- B. Project work includes, but is not limited to:
 - 1. A complete power distribution system including, but not limited to:
 - a. Panelboards
 - b. Motor control centers
 - c. Cable feeders
 - d. Safety and disconnect switches
 - e. Enclosed motor starters
 - f. Transformers
 - g. Overcurrent devices
 - h. Raceways
 - i. All other components shown on the Drawings, specified, or required for a fully operational system.
 - 2. A complete grounding system including, but not limited to:
 - a. Ground rods
 - b. Bonding
 - c. Ground conductors
 - d. Raceways
 - e. All other components shown on the Drawings, specified or required for a fully operational system.
 - 3. A complete lighting system including, but not limited to:
 - a. Lighting fixtures
 - b. Lamps

- c. Switches
 - d. Controls
 - e. Branch circuit wiring
 - f. Raceways
 - g. All other components shown on the Drawings, specified, or required for a fully operational system.
4. A complete branch circuit distribution system including, but not limited to:
- a. Branch and circuit wiring
 - b. Raceways
 - c. Wiring devices
 - d. Controls
 - e. Connections to motors and equipment
 - f. All other components shown on the Drawings, specified, or required for a fully operational system.
5. A complete heating and ventilation system including, but not limited to:
- a. Electric Unit Heaters
 - b. Ventilation Fans
 - c. Switches
 - d. Controls
 - e. Branch circuit wiring
 - f. Raceways
 - g. All other components shown on the Drawings, specified, or required for a fully operational system.
6. A complete system of miscellaneous electric controls and control wiring as shown on the Drawings and specified. Including but not limited to:
- a. Control System Integration
 - b. Control panels
 - d. Communication and Ethernet networks
 - e. System testing and commissioning
8. Electrical testing and certification as specified.
9. Concrete housekeeping pads, and other supports as required for electrical equipment and components.

10. Connections to equipment furnished by the General Contractor or other Divisions.
11. Connections for Owner-furnished equipment where shown on the Drawings or specified.
12. Additional items as shown on the Drawings or specified.
13. Contractor shall provide Arc-Flash Hazard Risk Assessment analysis, report, and labeling per NFPA 70e and IEEE 1584-2018. Analysis, report and labels shall be submitted to engineer for review. All data collection shall be verified by onsite contractor; all new cable lengths shall be measured while installing, all existing conductors shall be estimated by determining routing and measuring said routes via a tape wheel or other similar means. Arc Flash analysis shall be done on all power equipment, including all transformers (regardless of size), and control panels; both single phase and three phase analysis shall be done. Included in this study shall be a short circuit and selective coordination study. The report shall include, but not be limited to, a table of contents, be tabbed, all vendor/utility coordination information, any assumptions, any unknowns, and TCC curves for all overcurrent protective devices.
14. A complete snow melt system including, but not limited to:
 - a. Snow melt matting/cable
 - b. Termination kits
 - c. Power distribution
 - d. Controls and sensors
 - e. Branch circuit wiring
 - f. Raceways
 - g. All other components shown on the Drawings, specified, or required for a fully operational system.

1.03 RELATED SECTIONS:

- A. All division 23, 26 and 40 sections.

2.00 PRODUCTS

2.01 GENERAL:

- A. Refer to specific Sections of the Specification for equipment.

2.02 SNOW MELT CABLE AND HEATING SYSTEM

- A. Electric Snow Melting Matt: 2'x48', 208V/50W, single phase power, ProMelt or equal.

1. Matting shall be cut to fit designated area to be heated; install per manufactures requirements.

- B. Control System:

1. Control Panel: (4) 50 amp contactor panel; capable of connecting aerial and slab sensors for control. Manual control operated by time adjustable dial. ProMelt CP-200 Snow Melt Control Panel, or engineered reviewed equal.
 2. Aerial Sensor: Detects falling snow and automatically starts melting equipment. ProMelt Snow Sensor 095, or engineered reviewed equal.
 3. Slab Sensor Control Kit: Kit shall include a control touchscreen, surface mounted snow and ice accumulation sensor, and socket and outdoor temperature sensor. ProMelt Control Kit PM-L3, or engineered reviewed equal; kit includes PM-653 touchscreen, PM-070 snow/ice sensor, and PM-091 socket and outdoor temperature sensor.
- C. Submittal shall include all parts and pieces for a complete and fully functional snow melt system. Submittal shall include, but not be limited to, equipment layout, wiring diagrams, installation details, and electrical loading.
- D. Testing: Reference testing specification 26 01 26.

3.00 EXECUTION

3.01 GENERAL

- A. Installation shall be in accordance with the Specification section pertaining to the individual Equipment.

****END OF SECTION****

1.00 GENERAL

1.01 SECTION INCLUDES:

A. Basic requirements for electrical systems, including but not limited to:

1. Manner of running conduits
2. Hangers and supports
3. Attachment
4. Sleeves
5. Openings, cutting, and patching
6. Excavation, trenching, and backfilling
7. Access doors
8. Fire-stopping for conduit, bus-way, wire, and cable
9. Flame spread properties of materials
10. Penetration flashing and seals
11. Cleaning and painting of electrical work
12. Electrical system identification
13. Warning signs and operational tags
14. Prohibited markings
15. Equipment housekeeping pads and anchor bolts
16. Wiring device and equipment mounting heights

1.02 DESCRIPTION OF WORK:

A. This section covers the basic materials and methods of electrical construction as shown, scheduled, indicated, and specified.

1.03 DEFINITION:

A. For the purposes of providing materials and installing electrical work, the following definitions shall be used:

1. Outdoor Area: Exterior locations where the equipment is normally exposed to the weather and including below grade structures, such as vaults, manholes, handholes and in-ground pump stations.
2. Non-architecturally Finished Area: Mechanical, restrooms, corridors electrical rooms and other similar process-type rooms.

3. Wet and Corrosive Areas: Rooms or areas identified on the Drawings where there is a varying degree of spillage or splashing of corrosive materials such as water, wastewater or chemical solutions.
4. Highly Corrosive Areas: Rooms or areas identified on the Drawings or in the Specifications with potential for chronic exposure to corrosive, caustic or acidic agents, chemicals, chemical fumes or chemical mixtures.
5. Hazardous areas: Class I, II or III areas as defined in NFPA 70.
6. Shop Fabricated: Manufactured or assembled equipment for which a UL test procedure has not been established.

1.04 RELATED SECTIONS:

A. Related Sections include but are not necessarily limited to:

1. All Division 26 Sections.

1.05 STANDARDS AND REFERENCES:

A. American National Standards Institute (ANSI):

1. C2, National Electrical Safety Code
2. Z535.1, Safety Color Code
3. Z535.2, Environmental and Facility Safety Signs
4. Z535.3, Criteria for Safety Symbols
5. Z535.4, Product Safety Signs and Labels.

B. National Fire Protection Association (NFPA):

1. 70, National Electrical Code (NEC)
2. 79, Electrical Standard for Industrial Machinery

C. Occupational, Health and Safety Administration (OSHA):

1. 1910.145, Specification for Accident Prevention Signs and Tags

D. All materials and equipment specified herein shall within the scope of UL Examination Services, be approved by the Underwriter's Laboratories for the purpose for which they are used and shall bear the UL label.

1.06 SUBMITTALS:

A. Shop Drawings

1. See Section 26 60 00.
2. The Contractor shall submit to the Engineer, for review, a list of proposed manufacturers and product data on hangers, supports, and methods of attachment to the structure.
3. Cut sheets and samples of Electrical System Identification products.

4. Refer to Division 1 for additional submittal requirements.

1.07 DELIVERY, STORAGE, AND HANDLING:

A. See Section 26 60 00.

2.00 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

A. Refer to specific Division 26 sections and specific material paragraphs below.

B. Provide all components of a similar type by one manufacturer.

2.02 ELECTRICAL EQUIPMENT SUPPORTS:

A. Approved manufacturers:

1. Unistrut Building Systems

2. B-Line

3. Globe Strut

B. Material requirements:

1. Galvanized steel: ASTM A123 or ASTM A153

2. Stainless steel: AISI Type 316

3. PVC coat galvanized steel: ASTM A123 or ASTM A153 and 20 mil PVC coating

4. Fiberglass: Fire-retardant polyester or vinylester resin, ASTM E84, UL 94

2.03 NAMEPLATES:

A. For labeling equipment enclosures and equipment that is visible with the enclosure door closed:

1. Approved manufacturers catalog numbers:

a. W. H. Brady Co., #B-1.

b. Seton, "Setonply".

2. Materials: Phenolic, 2-ply engraved.

3. Size:

a. Surface: As required for the text.

b. Thickness: 1/16 IN.

4. Fabrication:

a. Two layer laminated.

b. Legend engraved through top lamination into bottom lamination.

c. Drilled holes in each corner, for screw mounting.

5. Colors: Black top surface, white core, unless otherwise indicated.
 6. Fasteners: Self-tapping stainless steel screws.
- B. For labeling components inside equipment enclosures:
1. Approved manufacturers catalog numbers:
 - a. W. H. Brady Co., “Industrial Strength Tape” #42018
 - b. Seton, “Component and General Identification Labels” #45553
 - c. Panduit, “Standard Labeling Tape” LS4-33
 2. Materials: vinyl tape or vinyl cloth with printable topcoat.
 3. Colors: White background, black printing.

2.04 WIRE MARKERS:

- A. For control panels, electrical gear, pull and junction boxes:
1. Material: vinyl or polyester tape.
 2. Approved manufacturer's catalog numbers:
 - a. W. H. Brady Co., Indoor/Outdoor Vinyl Tape, B-580
 - b. Seton, “Self-Laminating Wire Marker Labels” M7340
 - c. Panduit, LS4M “Industrial Labeling Tape”
 3. Material: Heat shrinkable polyolefin.
 4. Approved manufacturer's catalog numbers:
 - a. Seton, Welded Wire Marking Sleeves
 5. Colors: White background, black printing.
- B. For manholes, handholes and exterior pad mounted electrical gear:
1. Material: Aluminum or stainless steel.
 2. Approved manufacturer's catalog numbers:
 - a. Panduit META-X or META54-X
 3. Legend: Embossed.
 4. Fasteners: Nylon, urethane or polypropylene strap.

2.05 SAFETY SIGNS:

- A. Approved manufacturers catalog numbers:
1. W. H. Brady Co., #B-302 or #B-120
 2. Seton, Pressure Sensitive Vinyl or Tedlar Coated Plastic

3. Panduit, GMM Polyester Film (Type PPS) or GMPE1 Rigid Polyethylene (Type PRS)
- B. Materials, size and fabrication:
1. For indoor use: Polyester or vinyl, surface area as required by the text, 4 mil minimum thickness, self-adhesive.
 2. For outdoor use and on entrances to electrical rooms or stations: Fiberglass or coated plastic, surface area as required by the text, minimum area 7 x 10 IN, 60 mil thickness, drilled holes for screw mounting .
- C. Color in accordance with ASME (ANSI Z535.1, .2, .3 and .4) and OSHA 1910.145.
- D. Minimum letter size on indoor signs, 3/16 in.
- E. Maximize the letter size on outdoor signs to sufficiently fill the printable area on the sign.
- F. Standards: ASME/ANSI Z535.1, Z535.2, Z535.3 and Z535.4, OSHA 1910.145.

3.00 EXECUTION

3.01 MANNER OF RUNNING CONDUITS:

- A. All conduits shall be concealed in pipe chases, walls, furred spaces, topping, or above the ceilings of the building unless otherwise indicated.
- B. Conduit may be run exposed in mechanical rooms, duct and piping chases, but only where necessary. All exposed conduit shall be run in the neatest, most inconspicuous manner, and parallel or perpendicular to the building lines.
- C. All conduit and surface raceways shall be adequately and properly supported from the building structure by means recommended by the manufacturer, or by the use of hanger rods or clamps as herein specified.
- D. Where limited space is available above the ceilings and below concrete beams or other deep projections, conduit shall be sleeved through the projection where it crosses rather than hung below them in a manner to provide maximum above-floor clearance.
- E. No sleeves shall be installed through any concrete beam or other deep projection without written approval of the Engineer.
- F. Run conduit to avoid proximity to heat producing equipment, piping and flues, keeping a minimum of 8" clear.
- G. Whenever possible, install horizontal conduit runs above water piping.
- H. Install all conduit to allow for adequate maintenance and access clearances to all equipment and so as to not inhibit removal of ceiling tiles.
- I. The Contractor shall study all construction documents and carefully lay out all work in advance of fabrication and erection in order to meet the requirements of limited spaces. Where conflicts occur, the Contractor shall meet with all involved trades and the Construction Inspector and resolve the conflict prior to erection of any work in the area involved.

- J. Conduit and raceway connections, rough-in, and stub-up locations for equipment shall be coordinated by the Contractor to provide locations in locations indicated on approved manufacturers equipment shop drawings. Connection, rough-in and stub-up locations shown on the Drawings are diagrammatic for general reference only.
- 3.02 HANGERS AND SUPPORTS:
- A. All supports required for the proper installation of equipment, cable tray, wire-way, and conduit shall be provided as hereinafter specified unless otherwise indicated on the Drawings.
- B. All conduits throughout the building shall be supported as specified in Section 26 05 33, unless specifically noted differently on the Drawings or in the Specifications, but in every case shall be adequate to support the raceway being suspended. The supports shall be from the structure to line of grade, with proper provision for expansion, contraction, vibration elimination, and anchorage.
- C. Vertical conduits shall be supported from floor lines with riser clamps sized to fit the conduit and to adequately support their weight, with allowance for expansion and contraction. At the bases of conduit, where required for proper support, provide anchor base fittings or other approved supports.
- D. Conduit shall not be supported from ductwork, piping, or equipment.
- E. All electrical conduits and surface raceways exposed to view shall be run parallel to the adjacent building construction. All hangers shall be fastened to the building structure in a manner as hereinafter specified under "Attachment".
- F. Single conduits running horizontally shall be supported by Caddy, Minerallac, or approved equal; adjustable conduit hangers from adequately sized rods (minimum 1/8") from the building structure. Refer to Section 26 05 33 for additional requirements.
- G. Multiple conduits running horizontally shall be supported by trapeze channels suspended on rods or bolted to vertical building members. Channels shall be as manufactured by Unistrut, Superstrut, Kindorf, or approved equal. Conduits shall be secured to the channel with galvanized or stainless steel clamps. Refer to Section 26 05 33 for additional requirements.
- H. Vertical conduits, both concealed and exposed, shall be supported by clamping to vertical surfaces or by means of clamps resting on adjacent beams, or floor slabs, or both as required by the installation. Refer to Section 26 05 33 for additional requirements.
- I. Conduits and raceways run against building surfaces shall be supported by means recommended by the manufacturer, or by means of single or two hole rigid conduit clamps. Two-hole clamps shall be provided where size of conduit and installation conditions warrant Refer to Section 26 05 33 for additional requirements.
- J. All auxiliary steel required for conduit, cable tray, and wire-way supports, etc. shall be provided by the Electrical Trades unless specifically indicated to be provided by others. All support steel and fasteners shall be galvanized.
- K. Contractor shall review all Drawings, including Structural Drawings, for details regarding supports.

L. All supports shall be of type and arrangement to prevent excessive deflection, to avoid excessive bending stresses between supports, and to eliminate transmission of vibration.

M. Perforated strap shall not be used as a hanger material.

3.03 ATTACHMENT:

A. The load and spacing on each hanger and/or insert shall not exceed the safe allowable load for any component of the support system, including the concrete that holds the inserts. Reinforcement at inserts shall be provided as required to develop the strength required.

B. All conduits not embedded in concrete or masonry shall be securely and independently supported so that no strain will be transmitted to outlet box and pull box supports, etc. Supports shall be rigid enough to prevent distortion of conduits during wire pulling.

C. Inserts shall be of a type which will not interfere with reinforcing, as indicated on the Structural Drawings, and which will not displace excessive amounts of structural concrete. All methods of attachment to the structure and the use of after-set inserts shall be approved in writing by the Engineer.

D. All conduit supports shall be designed and installed to avoid interference with other piping, hangers, ducts, conduit, supports, building structures, equipment, etc. All conduit, cable tray, and wire-way shall be installed with due regard to expansion and contraction and the type of hanger method of support, location of support, etc. shall be governed in part by this Specification.

E. Hangers shall be attached to structure as follows:

1. Poured-in-place Concrete:

- a. Where conduits, equipment, etc., are supported under poured-in-place concrete construction, each hanger rod shall be fitted with a nut at its upper end, which shall be set into a UL-listed universal concrete insert placed in the form work before concrete is poured.
- b. Where inserts are placed in the bottom faces of concrete joists which are too narrow to provide adequate strength of concrete to hold the insert properly, or where a larger insert would require displacement of a bottom joist steel, the hanger rod shall be suspended from the center of a horizontal angle iron, channel iron, I-beam, etc., spanning across to adjacent joist. The angle iron shall be bolted to nonadjustable concrete inserts of the "spot" type, of physical size small enough to avoid the bottom joist steel.

2. Steel Bar Joist:

- a. Where light loads are supported under bar joists, hanger rods may be run with a washer and two nuts.
- b. Where larger loads are supported beneath bar joists, hanger rods shall be secured to angle irons of adequate size; each angle shall span across two or more joists as required to distribute the weight properly and shall be welded to the joists or otherwise permanently fixed thereto.

3. Steel Beams: Where loads are supported under steel beams, approved type beam clamps shall be used.
 4. Wood Framing: Where loads are supported from wood framing, hanger rods shall be attached to framing with side beam brackets or angle clips.
 5. Miscellaneous Steel: All miscellaneous steel members, angles, rods, supports, and similar items specified or required for this project shall be galvanized for indoor use or hot dipped galvanized for exterior use and where exposed to ambient conditions. All required miscellaneous steel shall be provided by this Division.
- F. Fastening of conduits, etc., in the building shall be as follows: To wood members - by wood screws; to masonry - by threaded metal inserts, metal expansion screws, or toggle bolts, whichever is appropriate for the particular type of masonry; to steel – machine – screws or welding (when specifically permitted or directed), or bolts, and to concrete by suitable inserts anchored to reinforcing steel, and poured in place unless other means are indicated on the plans. Power-actuated fasteners (shooting) will not be acceptable under any circumstances unless approved by the Engineer in writing.
- 3.04 SLEEVES:
- A. Provide sleeves for timely placing in construction for all conduit passing through concrete and masonry walls, partitions, beams, floors, and roofs while same is under construction.
 - B. In general, a conduit sleeve shall be one size larger than the size conduit which it serves, except where larger sizes are required for manufactured water stop fittings.
 - C. No sleeves shall be installed through any concrete beam or other deep projection without written approval of the Engineer.
 - D. Sleeves set in concrete floor construction shall be minimum 18 gauge, galvanized steel, and shall extend 2” above the finished floor. Where sleeve will be used to support a conduit riser clamp, sleeve gauge shall be increased accordingly.
 - E. Sleeves for concrete or masonry walls shall be Schedule 40; galvanized steel, and shall be set flush with the finished wall.
 - F. Sleeves for conduits that pass through walls below grade shall be wall sleeves with corresponding segmented annular seals for the conduit size required as specified herein.
 - G. Where sleeves are not properly set during construction and must be installed by cutting and patching, obtain direction from the Engineer prior to proceeding.
 - H. Sleeves are not required where new openings are core-drilled into existing construction, unless noted otherwise on the Drawings.
- 3.05 OPENINGS, CUTTING AND PATCHING:
- A. General:
 1. The Contractor shall be responsible for coordinating openings in the building construction for installation of electrical systems. Comply with the requirements of Division 1 for the cutting and patching of other work to accommodate the installation or

electrical work. Except as individually authorized by the Engineer, cutting and patching of electrical work to accommodate the installation of other work is not permitted.

B. Cut and Patch:

1. Cut and patch walls, floors, etc., resulting from work in existing construction or by failure to provide proper openings or recesses in new construction.

C. Methods or Cutting:

1. Openings cut through concrete and masonry shall be made with masonry saws and/or core drills and at such locations acceptable to the Engineer. Impact-type equipment may be used upon written approval of the Engineer. Openings in pre-cast concrete slabs for conduits, outlet boxes, etc., shall be core drilled to exact size.

D. Approval:

1. If holes or sleeves are properly installed and cutting and patching becomes necessary, it shall be done at no change in Contract amount. Undertake no cutting or patching without first securing written approval from the Engineer. Patching shall create a surface which is structurally and aesthetically equal to the surface surrounding the area patched and shall be performed by the trade whose work is involved at no change in the Contract amount.

E. Protection:

1. Openings through exterior walls or roofs shall be provided with suitable covers while they are left open to protect the property or materials involved. Any openings through walls below grade shall be properly protected to prevent entrance of water or other damaging elements.

F. Restoration:

1. All openings shall be restored to "as-new" condition under the appropriate Specification Section for the materials involved, and shall match remaining surrounding materials and/or finishes. Restoration work shall be performed by the trades who originally installed the work being restored and shall be performed at no cost to the Owner or Engineer.

G. Masonry:

1. Where openings are cut through masonry walls, provide and install lintels or other structural supports to protect the remaining masonry. Adequate supports shall be provided during the cutting operation to prevent any damage to the masonry occasioned by the operation. All structural members, supports, etc., shall be of the proper size and shape, and shall be installed in a manner acceptable to the Engineer.

H. Plaster:

1. All electrical work in areas containing plaster shall be completed prior to the application of the finish plaster coat. Cutting of finish plaster coat will not be permitted.

I. Special Note:

1. No coring, boring, or excavating which will weaken the structure shall be undertaken.

3.06 EXCAVATING, TRENCHING AND BACKFILLING:

A. General:

1. The work hereunder includes whatever excavating and backfilling is necessary to install the electrical work. Coordinate the electrical work in the same area, including excavating and backfilling, dewatering, floor protection provisions, other temporary facilities needed for protection and proper performance of excavating and backfilling.

B. Standards:

1. Except as otherwise indicated, comply with the applicable provisions of Division 2 for electrical work excavating and backfilling. Refer instances of uncertain applicability to the Engineer for resolution before proceeding with the Work.

- C. The bottoms of trenches shall be excavated to required depths, slope and grade. The bottom of the trench shall be accurately excavated to provide firm, uniform bearing for the bottom of the raceways and duct-banks. Where mud or unstable soil is encountered in bottom of trench, it shall be removed to firm-bearing and the trench shall be back filled with bedding sand to proper grade and tamped to provide uniform firm support.

- D. The bottom of trenches shall be accurately graded to provide proper fall and uniform bearing and support for each section of the conduit on undisturbed soil or 2" of sand fill at every point along its entire length. In general, grading for electrical duct-banks and conduits shall be from building to manhole, and from a high point between manholes to each manhole.

- E. Exercise care not to excavate below required depth, leaving a flat bed of undisturbed earth; firm and secure before laying cable and duct-banks. In the event rock is encountered, excavate 6" below required depth and backfill to required depth with bedding sand, and compact to minimum 95% compaction.

- F. All grading in the vicinity of excavation shall be controlled to prevent surface ground water from flowing into the excavations. Any water accumulated in the excavations shall be removed by pumping or other acceptable method. During excavation, material suitable for backfilling shall be stacked in an orderly manner a sufficient distance back from edges of trenches to avoid overloading and prevent slides or cave-ins. Material unsuitable for backfilling shall be wasted and removed from the site and properly disposed of.

- G. The Contractor shall be fully responsible for the safety of persons, materials and equipment in or near trenches or other excavations and provide all required sloping, shoring, railings and other protective provisions. The Contractor shall provide a trench shoring plan and design that is sealed by a registered professional engineer. Refer to Divisions 1 and 2 for additional requirements.

- H. If any unknown and/or uncharted utilities are encountered during excavation, promptly notify Engineer and wait for his/her instruction before proceeding,

- I. If such unknown utilities are encountered and work is continued without contacting the Engineer for instructions, and damage is caused to said utilities, the Contractor shall repair at his own expense, such damage to the satisfaction of the owner or utility company concerned.

- J. Trenches shall not be backfilled until all required tests have been made by the Contractor and approved by the Engineer and any local authorities having jurisdiction.
- K. Backfill shall be compacted or cement stabilized sand up to 6" above the top of conduit or duct-bank. Backfill up to grade shall be in maximum 6" lifts with minimum 95% compaction of lifts. Refer to Division 2 or elsewhere in Contract Documents for additional trenching and backfill requirements.
- L. Opening and Reclosing Pavement, Landscape Areas and Lawns: Where excavation requires the opening of existing walks, street, drives, other existing pavement or lawns; such surfaces shall be cut as required to install new conduit and to make new connections to existing conduits. The sizes of the cut shall be held to a minimum, consistent with the work to be accomplished. After the installation of the new work is completed and the excavation has been backfilled and flooded, the area shall be patched or replaced, using materials to match those cut out or removed. Patches shall thoroughly bond with the original surfaces; these shall be level with them and shall meet all the requirements established by the authorities having jurisdiction over such areas. All removed work shall be replaced by craftsmen who regularly install the types of work being replaced.
- M. Excavation in Vicinity of Trees:
 - 1. All trees, including low hanging limbs within the immediate area of construction, shall be adequately protected to a height of at least 5' to prevent damage from the construction operations and/or equipment. All excavation within the outermost limb radius of all trees shall be accomplished with extreme care. All roots located within this outermost limb radius shall be brought to the attention of the Engineer before they are cut or damaged in any way. The Engineer will give immediate instructions for the disposition of same. All stumps and roots encountered in the excavation that are not within the outermost limb radius of existing trees shall be cut back to a distance of not less than 18" from the outside of any concrete structure or pipeline. No chips, parts of stumps, or loose rock shall be left in the excavation. Where stumps and roots have been cut out of the excavation, clean, compacted, dry bank sand shall be backfilled and tamped.

3.07 FIRE-STOPPING FOR CONDUIT, WIRE, AND CABLE:

- A. General:
 - 1. Provide a UL Systems Classified, intumescent material capable of expanding up to eight to ten times when exposed to temperatures beginning at 250 degrees Fahrenheit for sealing all holes or voids created to extend electrical system conduit, raceways, bus-way, wire, cable, and other components through fire-rated floors and walls to prevent the spread of smoke, fire, toxic gas, and water.
- B. Fire barrier products shall be used to create through-penetration fire-stop systems as required.
- C. The products manufactured by 3M/Electrical Products Division or an approved equal are acceptable subject to Shop Drawing submittal approval.
- D. Install fire-stop materials according to the following UL Systems Classifications and manufacturer's recommendation:

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<u>OPENING TYPE</u>	<u>UL SYSTEM CLASSIFICATION NUMBER</u>
Metal Conduit/Metal Pipe Through Round Openings	No. 49, 95,147
Bus-way Through Rectangular Openings	No. 99
Insulation Power Cables/Telephone Cables Through Openings	No. 33, 49, 149
Blank Openings/Joints/Expansion Trenches	No. 92, 102, 61
Cable Tray (Single or Double)	No. 105
Metal Pipe/Conduit/Cables Through Large Openings	No. 93
Plastic Pipe/Plastic Conduit Through Openings	No. 64b, 148
All Other Fire-stop Systems	Per manufacturer's recommendations

- E. Provide fire rated insulation blankets around conduits where shown on Drawings. Blankets shall be one inch (1”), 8-pound density thermo ceramic material, Thermo Ceramics Kas-Wool Fire Master Series thermal blankets or an approved equal. Blankets shall be wrapped to provide continuous coverage and be secured with stainless steel bands in accordance with the manufacturer's UL-listed installation instructions

3.08 FIRE RATED PARTITIONS:

- A. Coordinate locations of raceways in fire-rated partitions so not to affect the fire rating of the partition. Notify the Engineer in writing where additional construction is required to maintain the partition fire rating.
- B. Outlet boxes installed in fire-rated partitions (2 hour or less) shall not exceed 16 square inches, with a maximum of 100 square inches or wall opening per 100 square feet of wall area.
- C. The outlet boxes shall be located whereby no two outlet boxes are installed closer than 24” on center, and securely attached to the partition studs, with at least one partition stud separating the outlet boxes.

3.09 FLAMESPREAD PROPERTIES OF MATERIALS:

- A. Materials and adhesives incorporated in this project shall conform to NFPA Standard 255 (1984), “Method of Test of Surface Burning Characteristics of Building Materials”. The classification shall not exceed a flame spread rating of 25 for all materials, adhesives, finishes, etc. specified for each system; and shall not exceed a smoke-developed rating of 50.

3.10 PENETRATION FLASHING AND SEALS:

- A. Conduit sleeves, pitch pockets, and flashings compatible with the roofing and waterproofing installation shall be provided for all roof and wall penetrations and roof-mounted equipment and supports. Coordinate flashing details with the Architectural details and the roofing/waterproofing contractors.
- B. Conduits passing through walls where exposed to weather or below grade shall pass through water-stop sleeves (new construction) or core-drilled openings (existing construction). The space between the conduit and sleeve/opening shall be sealed using segmented annular seals to prevent the entry of water or foreign materials. Segmented annular seals shall be Thunderline Incorporated; Type LS Series, Style C insulating type link seals for temperatures up to 250 degrees Fahrenheit, or approved equal. Water-stop sleeves shall be Thunderline Corporation, Century-Line or equal non-corroding thermoplastic sleeves with a molded in water stop.

3.11 CLEANING AND PAINTING OF ELECTRICAL WORK:

- A. Prime, protective touch-up painting is included in the Work of this Division. Finish painting in equipment spaces, concealed locations, and other locations not exposed to the view of building occupants is included in the work of this Division. Finished painting in areas exposed to the view of building occupants is specified under Division 9.
- B. All equipment and materials furnished by the electrical subcontractor shall be delivered to the job with suitable factory finish.
- C. Electrical switchgear, disconnect switches, contactors, etc., with suitable factory-applied finishes shall not be repainted; except for aesthetic reasons where located in finished areas as directed by the Engineer and in a color selected by the Engineer. Where factory-applied finishes are damaged in transit, storage or installation; or before final acceptance, they shall be restored to factory-fresh condition by competent refinishers using the spray process.
- D. All equipment not finished at the factory shall be given a prime coat and then finish painted with two coats of enamel in color as directed by the Engineer. No nameplates on equipment shall be painted, and suitable protection shall be afforded such plates to prevent their being rendered illegible during the painting operations.
- E. The surfaces finish-painted shall first be prepared as follows:
 - 1. Galvanized and black steel surfaces shall first be painted with one coat of galvanized metal primer.
 - 2. Aluminum surfaces shall first be painted with one coat of zinc chromate primer.
- F. All ferrous metal surfaces without protective finish and not galvanized, in exposed and concealed areas including chases, under floor and above ceilings, shall be painted with two coats of zinc chromate primer as the construction progresses to protect against deterioration.
- G. All junction and pull boxes and covers that are part of raceway systems distributing emergency power shall be painted red. Where a multiple branch emergency power system is installed, the branch designation (LS, CB or EQ) shall be stenciled on the box cover in minimum one inch (1") high white letters.

- H. All junction and pull boxes and covers and terminal cabinets that are part of the raceway/wiring system for fire alarm wiring shall be painted red. A system designation (FA) shall be stenciled on the box or cabinet cover in minimum one inch (1") high white letters.
 - I. All conduit and boxes exposed to view shall be finish painted as directed by the Engineer.
 - J. Before painting, all surfaces to be painted shall be suitably prepared. This shall include removing all oil, rust, scale, dirt, and other foreign material. Surfaces shall be made smooth by grinding, filing, brushing, or other approved method. In the painting operations, the primer for metal surfaces shall be of the zinc dust type unless specified otherwise, and where finish painting is specified, it shall be painted using materials and colors selected and approved by the Engineer. Refer to Division 9 for additional requirements.
- 3.12 WARNING SIGNS AND OPERATIONAL TAGS:
- A. Warning Signs: Provide warning signs where there is hazardous exposure associated with access to or operation of electrical facilities. Provide text of sufficient clarity and lettering of sufficient size to convey adequate information at each location; mount permanently in an appropriate and effective location. Comply with recognized industry standards for color and design.
 - B. Operational Tags: Where needed for proper and adequate information on operation and maintenance of electrical systems, provide tags of plasticized card stock, either preprinted or hand printed. Tags shall convey the message, example: "DO NOT OPEN THIS SWITCH WHEN PUMP IS OPERATING".
- 3.13 EQUIPMENT HOUSEKEEPING PADS AND ANCHOR BOLTS:
- A. Concrete pads for electrical equipment (Housekeeping Pads) will be furnished under this Division.
 - 1. All concrete used in light pole bases shall be 5 sack mix with 1/2" maximum aggregate and 3000 psi compressive strength when tested after 28 days in accordance with ASTM 039-44, "Standard Method of Test for Compressive Strength of Concrete". Refer to Division 3 for additional requirements.
 - 2. Use forms except where the earth is firm enough to support the concrete. Above grade portions of pole bases shall be formed using Sonatube or an approved equal forming system.
 - 3. Keep concrete wet at least 48 hours after forms are removed to ensure proper curing.
 - 4. Light pole bases shall be reinforced where noted on the Drawings. Refer to Division 3 for reinforcing steel.
 - 5. All floor mounted equipment installed in the electrical room shall be installed on a concrete housekeeping pad.
 - B. Pads shall be nominal 3-1/2" high and shall extend a minimum of 3" beyond all equipment and supports while generally conforming to the shape of the equipment.
 - C. Furnish galvanized anchor bolts with layout templates for installation in equipment pads. Bolts shall be of the size and quantity recommended by the manufacturer and where vibration isolators are used, they will be anchor bolted to the equipment pad.

3.14 WIRING DEVICE AND EQUIPMENT MOUNTING HEIGHTS:

- A. Refer to architectural drawings to determine whether outlets occur in wainscot or cabinet spaces and coordinate mounting heights as required by architectural form. For example, mounting heights of outlets occurring in a tile or brick wall should be adjusted so that the outlet will occur entirely within a single course. However, all outlets in a given space shall be mounted at the same height.
- B. In general, unless noted otherwise on Architectural or Electrical Drawings, mounting heights to device centerline shall be as follows:

Wall Switches	48" above finished floor.
Receptacles	18" above finished floor.
Panelboards	72" from finish floor to top of panel board.
Stairway Lighting Fixtures	Wall mounted 7'-6" above finished floor or mid-landing, or as indicated on the drawings.
Telephone and Data Processing Outlets	18" above finished floor.

- C. All receptacles shall be mounted with their long axis vertical, unless noted otherwise.

3.15 DEMOLITION AND WORK AT EXISTING SITE:

- A. The Contractor shall be responsible for loss or damage to the existing facilities caused by him and his workmen, and shall be responsible for repairing or replacing such loss or damage. The Contractor shall send proper notices, make necessary arrangements, and perform other services required for the care, protection, and in-service maintenance of all electrical services for the new and existing facilities. The Contractor shall erect temporary barricades, with necessary safety devices, as required to protect personnel from injury, removing all such temporary protection upon completion of the work.
- B. The Contractor shall provide temporary or new services to all existing facilities as required to maintain their proper operation when normal services are disrupted as a result of the work being accomplished under this project.
- C. Where existing construction is removed to provide working and extension access to existing utilities, Contractor shall remove doors, conduit, outlet boxes, wiring, light fixtures, equipment, and similar items, to provide this access and shall reinstall same upon completion of work in the areas affected.
- D. Outages of services as required by the new installation will be permitted but only at a time approved by the Owner. The Contractor shall allow the Owner 2 weeks in order to schedule required outages. The time allowed for Outages will not be during normal working hours, unless otherwise approved by the Owner. All costs of outages, including overtime charges, shall be included in the contract amount.
- E. The Contractor shall modify, remove, and/or relocate all materials and items so indicated on the Drawings or required by the installation of new facilities. All removals and/or dismantling shall

be conducted in a manner as to produce maximum salvage. Survey the project with the Owners representative before demolition begins and determine all materials that the Owner specifically chooses to have salvaged. Pre-establish with the Owner locations where salvaged materials are to be stored. Salvage materials shall remain the property of the Owner, and shall be delivered to such destination as directed by the Owner. Materials and/or items scheduled for relocation and which are damaged during dismantling or reassembly operations shall be repaired and restored to good operative condition. The Contractor may, at his discretion and upon the approval of the Owner, substitute new materials and/or items of like design and quality in lieu of materials and/or items to be relocated.

- F. All items which are to be relocated shall be carefully removed in reverse to original assembly or placement and protected until relocated. The Contractor shall clean and repair and provide all new materials, fittings, and appurtenances required to complete the relocations and to restore to good operative order. All relocations shall be performed by workmen skilled in the work and in accordance with standard practice of the trades involved.
- G. When items scheduled for relocation are found to be in damaged condition before work has been started on dismantling, the Contractor shall call the attention of the Owner to such items and receive further instructions before removal. Items damaged in repositioning operations are the Contractor's responsibility and shall be repaired or replaced by the Contractor as approved by the Owner, at no additional cost to the Owner.
- H. Service lines and wiring to items to be removed, salvaged, or relocated shall be removed to points indicated on the Drawings, specified, or acceptable to the Owner. Service lines and wiring not scheduled for reuse shall be removed to the points at which reuse is to be continued or service is to remain. Such services shall be sealed, capped, or otherwise tied-off or disconnected in a safe manner acceptable to the Owner. All disconnections or connections into the existing facilities shall be done in such a manner as to result in minimum interruption of services to adjacent occupied areas. Services to existing areas or facilities which must remain in operation during the construction period shall not be interrupted without prior specific approval of the Owner as hereinbefore specified.
- I. Certain work during the demolition and alteration phases of construction may require overtime or nighttime shifts or temporarily evacuation of the occupants. Coordinate and schedule all proposed down time with the Owner's Representative at least 72 hours in advance.
- J. Make every effort to minimize damage to the existing Owner's property. Repair, patch, or replace as required any damaged which might occur as a result of work at the site. Care shall be taken to minimize interference with the Owner's activities during construction. Cooperate with the Owner and other trades in scheduling and performance of the work.
- K. Include in the contract price all rerouting of existing conduits, wiring, outlet boxes, fixtures, etc., and the reconnecting of existing fixtures as necessitated by field conditions to allow the installation of the new systems. Furnish all temporary conduit, wiring boxes, etc., as required to maintain lighting and power service for the existing areas with a minimum of interruption.
- L. All existing lighting fixtures, switches, outlets, materials, equipment and appurtenances not included in the remodel or alteration areas are to remain in place and shall remain in service.

- M. Electrical equipment, outlets, circuits to mechanical and building systems equipment, etc., which are to remain but which are served by conduit and/or circuiting that is disturbed by the remodeling work, shall be reconnected in such a manner as to leave it in proper operating condition.
- N. Existing branch circuit wiring which is to be removed, shall be pulled from the raceways and the empty conduit shall be removed to a point of permanent concealment
- O. Existing lighting fixtures shown to be removed and indicated to be reused, shall be cleaned, repaired, re-lamped and provide with such new accessories as may be needed for the proper installation in their new locations.
- P. New circuiting indicated to be connected to existing panels shall be connected to "spares" and/or "released" breakers as applicable, or new breakers provided where space is available. Contractor shall verify the existing panel load and feeder capacity prior to adding any additional loads.
- Q. Within the remodeled or alteration areas where existing walls are being removed, all existing lighting fixtures, switches, receptacles, other materials and equipment and their appurtenances shall be removed, where required by the remodel work either shown or specified.
- R. Any salvageable equipment as determined by the Owner, shall be delivered to the Owner, and placed in storage at the location of his choice. All other debris shall be removed from the site immediately.

END OF SECTION

1.00 GENERAL

1.01 SECTION INCLUDES:

A. Material and installation requirements for:

1. Motors
2. Submittal requirements

1.02 DESCRIPTION OF WORK:

- A. This section covers motors which are supplied with and as part of connected equipment specified in other sections of this specification.
- B. Special provisions, requirements and/or revisions to this Specification and/or Bid Item(s) may be included on the Drawings or Details.

1.03 RELATED SECTIONS:

A. Related Sections include but are not necessarily limited to:

1. Section 26 60 00 – Electrical General Provisions
2. Section 26 60 02 – Basic Materials and Methods
3. Section 26 05 19 – Wire and Cable
4. Section 26 05 33 – Raceways
5. Section 26 90 10 – Variable Frequency Drives
6. Section 26 90 20 – Motor Control Centers
7. Section 26 90 22 – Pump Control Panel

1.04 STANDARDS AND REFERENCES:

- A. All materials and equipment specified herein shall within the scope of UL Examination Services, be approved by the Underwriter's Laboratories for the purpose for which they are used and shall bear the UL label.
- B. All materials and equipment specified herein shall conform with all applicable NEMA, ANSI and IEEE Standards
- C. All materials and equipment specified herein and their installation methods shall conform to the latest published version of the National Electrical Code, NEC.

1.05 SUBMITTALS:

A. Shop Drawings

1. See Section 26 60 00.
2. Drawings and Data: Catalog information and complete name-plate and efficiency information.

3. Motor wiring and connection diagrams for all provided external connections including power, overtemp contacts, space heaters, moisture sensors, etc.
4. Physical drawing showing electrical connection.
5. Motor terminal connection box size.
6. Refer to individual equipment specification requirements.
7. Submit the motor manufacturer's certification of conformance to the specified bearing life on all motors 20 horsepower and larger. Also submit, upon the Engineer's request, certification of bearing life on smaller motors.
8. For motors provided with cords, provide complete information on the cord including:
 - a. Length, number and size of conductors, overall diameter, materials, ratings, etc.
9. For motors with special requirements for protection such as overtemp, moisture, overtorque, etc. from electrical controls or components, submit detailed information on equipment, installation, and control wiring requirements.
10. For motors on VFD's:
 - a. Provide data on expected speed range of load being served.
 - b. Provide proof of inverter duty rating and insulation rating as specified.
 - c. Provide indication that motor is provided with a shaft grounding ring; all VFD driven motors shall be provided with shaft grounding rings.

1.06 DELIVERY, STORAGE, AND HANDLING:

- A. See Section 26 60 00.

2.00 PRODUCTS

2.01 GENERAL:

- A. Unless specifically excepted, all motors shall be "premium efficiency" type which meet the minimum efficiencies required by the Washington State energy codes and the Energy Policy Act. Normal efficiency motors shall not be supplied. In addition, all motors shall have a minimum power factor rating of .85 at full load, motors rated at a lower power factor shall not be supplied.
- B. Provide motors in accordance with standard NEMA type classifications as specified. The use of industry standard sub classifications such as "Mill and Chemical" motors and similar "standard" heavy-duty designs are encouraged where they meet or exceed the specified minimum requirements.
- C. All Motors shall be suitable both electrically and mechanically to drive the connected equipment under any and all modes of operation. The speed, horsepower, torque, base, bearing, shaft, insulation, and enclosure shall be closely coordinated with equipment requirements specified herein and in other portions of this specification so as to provide a satisfactory, efficient drive without overloading, overheating, abnormal noise or vibration.

- D. All Motors shall be designed and built for long, trouble-free life in industrial service and shall be capable of operating successfully under the following application conditions:
1. 40° C maximum ambient temperature to -20° C minimum ambient temperature,
 2. 3,300 ft. maximum altitude,
 3. Voltage variations to plus or minus 10% of nameplate rating,
 4. Frequency variations to plus or minus 5% of nameplate rating,
 5. Variable speed motors shall be suitable for use with variable speed controller,
 6. .85 minimum full load power factor.
- E. All motors shall be rated for full voltage starting, NEMA Design B, normal torque, normal starting current, unless otherwise required by the driven equipment or specified.
- F. All motors shall be suitable for the environment in which they are to be installed.

2.02 ENCLOSURES:

- A. Totally enclosed fan cooled (TEFC) unless otherwise specified.
- B. Hazardous areas (as scheduled in Section 26 60 02) - explosion proof non-ventilated - (XPNV) or fan cooled (XPFC).
1. Cast iron stator frames and end shields, rigid construction.
 2. Heavy fabricated steel, or cast iron for single phase motors.

2.03 MOTOR ACCESSORIES:

- A. Motor Leads: Provide motor leads compatible with motor insulation system, permanently identified.
- B. Eyebolts: Provide drilling and tapping for eyebolts on all motors weighing more than 83 pounds.
- C. Nameplates: Provide two engraved stainless steel stamped metal nameplates (one for the motor and one for mounting in the motor starter enclosure or MCC starter bucket), with the information required by NEMA-MG1 and the following additional information:
1. Maximum ambient temperature for which motor is rated,
 2. Class of insulation,
 3. Service factor,
 4. Bearing part number,
 5. Motor connection diagram if more than three leads,
 6. Power rating in kW if driven equipment ratings are given in metric units,
 7. Voltage and wattage of internal space heaters.

- D. All single-phase motors shall be self-protected unless specified "for separate protection", and the self-protection characteristic shall be indicated on the motor nameplate. Protection shall be manual or automatic-reset type as specified or required by safety considerations of the equipment served.
- E. Single phase motors shall be provided with start capacitors if necessary for proper operation of the motor. The start capacitors shall be located within the motor housing.
- F. Enclosed Motors: Provide drain plugs for non-explosion proof motors and drain and breather for explosion proof motors.
- G. Finish: Provide a prime and final finish of the manufacturer's standard colors.
- H. Provide embedded thermostats for thermal alarm or motor cut out for all motors 40 Hp and above unless otherwise shown.
- I. For motors 100hp and larger, motors shall be equipped with a thermal protection system. Six thermistors shall be provided with the motor, two embedded in each phase coil, which will protect the motor windings from damaging temperatures resulting from motor overload, too frequent starting, blocked air passages, and locked rotor. One thermistor in each winding shall be connected to the monitor, the other shall be an installed spare. A thermal monitoring relay operating at 120Vac shall be mounted in a NEMA 4 enclosure mounted near the main conduit box where it does not obstruct access to that box. Provide the relay with a normally open, held closed contact rated 5A, 120Vac minimum which shall open automatically on abnormally high thermistor temperature.

2.04 MOTOR TERMINAL CONNECTION BOX:

- A. Provide a terminal connection box two sizes larger than normal to allow extra room for motor feeder splices.
 - 1. Refer to Section 26 05 19 – Wire and Cable.
 - a. Motor Terminal Splice Insulation
- B. Conduit Entrance: Provide conduit entrance box on the right-hand side of all horizontal motors, when facing motor end opposite shaft extension unless otherwise detailed on the drawings or required by the unique characteristics of the equipment served. Provide conduit entrance box size and drilling to conform to the conduit or wiring requirements indicated on the electrical drawings. Include motor leads and all accessory leads in a common conduit entrance box.

2.05 INSULATION CLASS:

- A. Provide NEMA Class B insulation with additional nonhygroscopic moisture protection which will maintain a minimum resistance of 1.0 megohms after 168 hours of exposure at 100% humidity.
- B. Class F insulation with additional nonhygroscopic moisture protection as specified above may be utilized at the Contractor's option, however, the temperature rise as measured by resistance when operating at rated service factor and load shall conform to the limiting observable temperatures in NEMA-MGI, for class B insulation.
- C. Class A insulating materials shall not be utilized.

2.06 MOTORS ON VARIABLE FREQUENCY DRIVES (VFD's):

- A. Motors for use with VFD's shall be inverter duty rated. Inverter duty rated motors shall meet the requirements of NEMA MG1, Part 31. Insulation rating shall be 2100V minimum. The Contractor shall coordinate between the VFD and motor manufacturers to provide a motor/VFD combination suitable for the application.
- B. Provide motors with adequate cooling for the lowest expected speed for load served.
- C. Any line terminators, filtering devices, harmonic filters, line reactors, or other devices required for proper operation of the motor/VFD combination shall be provided and installed by the Contractor at no additional cost to the Owner.

2.07 SERVICE FACTOR:

- A. The rated nameplate horsepower of the motor, when operating at a service factor of 1.0, shall be equal to or greater than the horsepower required to drive the connected equipment under any and all modes of operation.
- B. Provide motors with a 1.15 service factor.

2.08 SUBMERSIBLE MOTORS:

- A. Definite purpose submersible motors shall conform to the following:
 - 1. Motor shall be designed for service in a liquid temperature of 25° C. Set controls to permit operation only when fully submerged unless specifically rated for non submerged duty.
 - 2. Motor shall have two mechanical seals; the lower one outside the motor and protecting the upper one which shall be in an oil filled chamber.
 - 3. Provide embedded thermostats for thermal alarm or motor cut-out.
 - 4. Provide water detector probes in seal oil chamber.
 - 5. Provide one or more multiconductor cables of approved construction and suitable length to extend from the motor to the indicated receptacle or junction box. Provide strain relief for the cable.
 - 6. Separate cables shall be provided for power and alarm conductors.
 - 7. Provide control wiring connection diagram and all necessary components, relays, etc. for the required and proper control and shutdown of the motor. Provide descriptive information to the Engineer and/or System Integrator on the control of the equipment.

2.09 POWER RATINGS:

- A. Motor horsepower, if indicated in the detailed equipment specifications, are minimum size acceptable.
- B. Ratings indicated on the electrical drawings are for guidance only and do not limit the equipment size.

C. Frame/hp relationships shall conform to the latest NEMA standards for "T" or "U" frames, and all dimensions shall meet NEMA standards.

2.10 SYNCHRONOUS SPEED:

A. In general, the motor speed indicated is the rated synchronous speed. Provide motor rated full-load speeds which are compatible with the specified performance of the driven equipment.

2.11 STANDARD RATED VOLTAGE PHASE AND FREQUENCY:

A. Provide motors nameplate-rated for 60 hertz power supply as follows unless otherwise specified or shown on the drawings:

1. Motors less than 1/6 hp, single-phase, 115V.
2. Motors 1/6 hp to 1/2 hp, single-phase, 115/230V.
3. Motors 1/2 hp through 100 hp, three-phase 230/460V.
4. Multi-speed and part winding start motors may have single voltage rating if manufacturer's standard.

B. Conform to the specified service conditions and the equipment specifications without reduction in the service factor.

2.12 BEARINGS & SHAFTS:

A. All bearings shall be anti-friction-type AFBMA standard sizes. All motors shall provide a minimum bearing life of 20,000 hours. All motors shall have thrust ratings not less than the combined static and dynamic loads to be imposed.

B. Shafts shall be in accordance with NEMA "T" or "TS" dimensions. Long shafts shall be suitable for belt, chain or gear drive within limits established by good industrial practice and documented by NEMA. Short shafts shall be used for direct connection. Vertical motors shall be the solid-shaft type except where application requires a hollow-shaft design.

C. Balance and Vibration: Conform to NEMA standard, MG1, latest revision.

2.13 DUTY CYCLE:

A. Provide motors rated for continuous duty unless otherwise specified.

2.14 LUBRICATION:

A. Horizontal polyphase motors shall be grease lubricated. The bearing housing shall be large enough to hold sufficient lubricant to minimize the need for frequent re lubrication but facilities shall be provided for adding new grease and draining out old grease without major motor disassembly. Motors 180T frame and smaller may utilize grease release fitting in lieu of grease drain plug. The bearing housing shall have long, tight, running fits or rotating seals to protect against the entrance of foreign matter into the bearings or leakage of grease out of the bearing cavity.

B. Vertical polyphase motor lubrication shall conform to the motor manufacturer's recommendations. Except as otherwise recommended, guide bearings shall be ball bearings,

grease lubricated; thrust bearings shall be grease lubricated through frame 280T, oil lubricated in larger frame sizes.

2.15 EFFICIENCY

- A. Efficiency shall be determined by testing production motors with a dynamometer at rated output, voltage and frequency in accordance with IEEE Specification 112A, Paragraph B.

2.16 SHOP TESTS:

- A. Each polyphase motor shall be given a routine test to determine that it is free from electrical or mechanical defects and provide assurance that it meets the specifications. The routine test shall conform to applicable NEMA and IEEE Standards latest revision.
- B. Copies of the test report will not be required unless actual operation and installation suggest the motors' performance should be verified, in which case certified copies of the test report shall be submitted upon the Engineer's request.

3.00 EXECUTION

3.01 INSTALLATION:

- A. Motors shall be factory installed on common bases, stands, etc., with the driven equipment. Provide suitable couplings and guards between motor and driven equipment.
- B. Align and connect to driven equipment.
- C. Provide suitable personnel guards over all shafts, couplings, or other exposed moving parts.
- D. Connect motors to power supply and controllers.
- E. Verify correct rotation of equipment.
- F. Connect motor leads with a splice kit specifically designed for motor lead connection.
 - 1. Refer to Section 26 05 19 – Wire and Cable.

3.02 INSTALLATION CHECK:

- A. Provide services of an experienced, competent, and authorized representative of manufacturer to visit site of work to inspect, check, adjust if necessary, and approve equipment installation for motors.
- B. Assure that equipment manufacturer's representative is present when equipment is placed in operation.
- C. Verify that equipment representative revisits job site as often as necessary until all trouble is corrected and equipment installation and operation are satisfactory, at discretion of Engineer.
- D. Verify that motor overcurrent protection is in accordance with the NEC.
- E. Verify the motor protection and control is in accordance with the equipment manufacturer's requirements.
- F. The Contractor shall open each motor terminal box for inspection by the Engineer.

3.03 TESTS:

- A. The Contractor shall simulate all motor alarm and shutdown conditions to test that the motor control is operating correctly. These tests shall be witnessed and verified by the Engineer.
- B. The Contractor shall perform voltage, current and resistance tests as required to complete the Motor Test Report.
 - 1. Refer to Section 26 01 26 – Testing.
 - 2. The Contractor shall inform the Engineer a minimum of 3 days in advance of testing and shall only perform tests with the Engineer or Owner’s representative present.
- C. If the test results indicate corrective measures are required, the Contractor shall undertake all such corrective measures until the electrical system is accepted by the Engineer. No additional compensation will be paid for corrective measures.

END OF SECTION

1.00 GENERAL

1.01 SUMMARY:

This Section covers includes the general requirements for furnishing, installing, adjusting, testing, documenting, and startup of the complete and functional Instrumentation and Control System (I&C).

Major components of this system include, but are not limited to, all materials, equipment, and work required to implement a complete and operating system as described herein. The system shall include primary elements for process variable measurements, control elements, analog displays, communication systems, and all hardware and software required to program, calibrate and monitor the instrumentation, communication and control devices.

The Contractor shall provide, calibrate, and assist with the testing of the complete instrumentation and control system. The Contractor shall assist to place the completed system in operation, including tuning loops, testing and adjusting communications and making final adjustments to instruments and equipment as required during system start-up. The Contractor shall provide the services of trained and qualified instrument technicians for these services.

1.02 PROJECT DESCRIPTION:

Improvements will be constructed at the City of Leavenworth's Waste Water Treatment Facility (WWTP).

Major areas of upgrades include a new Tertiary building, Filter Feed pump station, UV system, clarifier upgrades, mixers, and associated instrumentation.

The PLC control system will be upgraded, as well as the SCADA monitoring system.

1.03 DEFINITION OF TERMS:

- A. Contractor: The party who furnishes and installs all tools, materials, and equipment to complete the work shown and implied in the drawings and these specifications. This includes the Prime Contractor, the Electrical Contractor, System Integrator, Programmer and all other Contractors and Subcontractors.
- B. System Integrator: An organization engaged in the business of detail design, component selection and procurement, fabrication, wiring, assembly, programming and testing process control and telemetry systems.
- C. Programmer: The organization that has been pre-selected by the Owner to provide the programming and software development for the PLC and SCADA process control systems. Programmer services shall be provided by the City under separate contract.
- D. Equipment Supplier: The equipment manufacturing company of treatment or other specialty systems, responsible for providing all materials, equipment, and testing for a fully operational system.

1.04 SPECIAL REQUIREMENTS:

- A. The Contractor shall install components including those assembled by the System Integrator at the locations shown in the plans, and in accordance with the requirements of Division 26.

- B. The Contractor shall be responsible for the selection of the System Integrator, and shall be subject to approval by the Engineer. The System Integrator shall be a control system manufacturing company that conforms to the following minimum requirements:
1. The System Integrator's manufacturing and testing facility shall be located within 200 miles from the project location.
 2. The System Integrator shall be specialized in the design, assembly, testing, installation and service of municipal control and communication systems in the Pacific Northwest for at least the last five years.
 3. The System Integrator shall employ technicians and engineers with documented experience in the design, assembly, testing, installation, operation, calibration, troubleshooting, service and repair of control and communication systems for municipal systems and facilities.
 4. The System Integrator shall have completed the design, assembly, testing and installation of control systems with similar application and complexity to the listed project, and which include the instruments and devices cited on the plans by specific manufacturer's name.
 5. The System Integrator shall be a UL listed and certified control panel manufacturing facility.
- C. Integrators not listed below shall be subject to written approval by the Engineer prior to bid.
- D. Pre-approved System Integrators are:
1. Systems Interface Inc, Mukilteo WA.
 2. Quality Controls Corporation, Lynnwood WA.
 3. Technical Systems Inc, Lynnwood WA.
 4. Process Solutions Inc, Arlington, WA
 5. Control Freek Inc, Spokane WA
 6. Superior Custom Controls, Seattle, WA
 7. Woodhawk Controls, Coeur D'alene, ID

1.05 DIVISION OF RESPONSIBILITY:

- A. All materials and modifications to the existing control system shall be provided under the supervision of a single Contractor, which is regularly engaged in the design and installation of such systems of similar scope and complexity.
- B. The Contractor shall be fully and completely responsible for all work performed and all materials installed under the contract. The contract between the Contractor and subcontractor(s) shall conform to and meet all requirements specified in the contract documents.
- C. Electrical Contractor's Responsibility

The Electrical Contractor shall be responsible for the following:

1. Installation of the all electrical, instrumentation and control system equipment in accordance with these documents, drawings or instructions of the Equipment Supplier(s), and System Integrator.
2. Provide electrical panels, instrumentation, raceway and other equipment and installation as shown on the drawings and specifications.
3. Coordination with the Engineer and Owner for the equipment installation and treatment facility downtime requirements.

D. System Integrator Responsibilities

The System Integrator shall be responsible for the following:

1. Provide Motor Control Centers, Local Control Panels, PLC control system, and communications equipment.
2. Provide and configure all VFDs, instrumentation and other process control equipment.
3. Provide additional system accessories as required for a complete and operational control system.
4. Attend system startup and testing, perform all I/O testing and verification, assist Contractor and Programmer as required.
5. SCADA computer hardware will be provided by the Owner.
6. SCADA and PLC software programming development and runtime licenses will be provided by the Owner.

E. Programmer Responsibilities

The Programmer shall be responsible for the following:

1. Provide treatment facility PLC programming as required for monitoring and control of new and existing WWTP control system equipment.
2. Provide treatment facility SCADA programming as required for monitoring and control of new and existing WWTP control system equipment.
3. Attend system startup and testing as required by Electrical Contractor and System Integrator.

F. Equipment Supplier Responsibilities

The Equipment Supplier shall be responsible for the following:

1. Provide all packaged equipment and installation requirements for Electrical Contractor installation.
2. Fully program, commission, adjust, test and put the new equipment into operation.
3. The Equipment Supplier shall address any PLCs with IP addresses as specified by the Programmer.
4. The Equipment Supplier shall organize and allocate specific memory locations and PLC tags, as required, for complete monitoring of the equipment by the treatment facility PLC and SCADA system. These listings shall be provided to the Programmer prior to startup and commissioning.

G. Fiber Optic Contractor's Responsibility

The Fiber Optic Contractor shall be responsible for the following equipment and services:

1. Selection of the Fiber Optic system cabling, patch panels, patch cables, and other equipment required for a complete and operational system.
2. Installation Fiber Optic system cabling, patch panels, patch cables, and other equipment.
3. Testing, certification and commissioning of the complete Fiber Optic system.

1.06 SUBMITTALS:

A. Hardware Submittals

In addition to the requirements stated elsewhere in these documents, the following information shall be provided:

1. Before any components are fabricated, and/or integrated into assemblies, or shipped to the site, the System Integrator shall prepare a complete hardware submittal.
2. Provide review sets to the Engineer for review; including fully detailed 11 x 17 Auto CAD shop drawings, catalog cuts, wiring connections, and such other documentation as may be required to fully describe the equipment and to demonstrate its conformity to these plans and specifications.
3. The decision of the Engineer, upon the acceptability of any submittal, shall be final.
4. Catalog information shall be submitted for all components and equipment required for the project.
5. All submittals shall be complete, organized, and indexed. Partial submittals will not be accepted.

B. System Drawing Submittals

1. Following approval of the Hardware Submittal, the System Integrator shall prepare complete system wiring diagrams and panel layout drawings for approval.

1.07 OPERATION AND MAINTENANCE MANUALS:

Provide Operation and Maintenance (O&M) data for the complete control system and related equipment, in accordance with the general requirements in Section 26.

2.00 PRODUCTS

2.01 GENERAL:

Material shall be new, free from defects, and of the quality specified. All equipment and materials utilized in the system shall be the products of manufacturers with at least five (5) years experience in the manufacture of similar equipment. Similar items in the system shall be the products of the same manufacturer. All equipment shall be of industrial grade and shall be specifically intended for control and monitoring of operation of motor-driven pumps and equipment. All equipment shall be of modular design to facilitate interchangeability of parts and to assure ease of servicing.

2.02 MAJOR EQUIPMENT LIST:

A. The Contractor shall provide all of the equipment shown on the drawings, including but not limited to, the following major Control System equipment:

1. PLC control panels as shown on the drawings. Contractor shall provide detailed design drawings, bill of materials and data sheets for complete control system.
2. Local and remote control panels, as shown on the drawings.
3. Instrumentation as shown on the drawings, and specified herein.
4. Fiber optic and networking equipment.
5. Installation of all packaged equipment system panels, equipment and instrumentation per manufacturer drawings.

2.03 INSTRUMENTATION:

A. ULTRASONIC TRANSMITTER

1. Provide ultrasonic non-contact level measurement system.
2. The transducer shall be mounted inside the wet well to measure the fluid level.
3. The transducer shall be constructed of chemical resistant materials, and FM rated for installation in Class 1 Div 1 locations, and intrinsically safe.
4. The transducer shall be mounted so that it is above the maximum fluid level by more than the blanking distance. Typical blanking distance value is 1.0 foot. The transducer shall be mounted so the axis of transmission is perpendicular to the liquid surface.
5. Provide mounting assembly per manufacturers recommendations. All mounting assembly materials shall be Type 316 stainless steel.
6. The meter shall be designed to operate from a 4-20 mA DC powered loop, 12 – 30V DC.
7. The ultrasonic measurement system shall have a measurement range of .8 to 16 feet. The range of measurement shall be programmable.
8. Manufacturer: Siemens Milltronics ‘The Probe’, or approved equal.

B. RADAR LEVEL TRANSMITTER

1. Provide Radar technology non-contact level measurement system.
2. The transducer shall be mounted inside the wet well to measure the fluid level.
3. The transducer shall be constructed of chemical resistant materials, and FM rated for installation in Class 1 Div 1 locations, and intrinsically safe.
4. The transducer shall be mounted so that it is above the maximum fluid level by more than the blanking distance. Typical blanking distance value is 1.0 foot. The transducer shall be mounted so the axis of transmission is perpendicular to the liquid surface.
5. Provide mounting assembly per manufacturers recommendations. All mounting assembly materials shall be Type 316 stainless steel.
6. The meter shall be designed to operate from a 4-20 mA DC powered loop, 12 – 30V DC.
7. The ultrasonic measurement system shall have a measurement range of .8 to 16 feet. The range of measurement shall be programmable.
8. Manufacturer: Endress Hauser FMR20 HART free space radar, or approved equal.

C. GAS MONITOR

1. Provide combustible gas monitors for Hazardous locations, as shown on the drawings.
2. The monitor shall be constructed of chemical resistant materials, and FM rated for installation in Class 1 Div 1 locations, and intrinsically safe.
3. Provide mounting assembly per manufacturers recommendations. All mounting assembly materials shall be Type 316 stainless steel.
4. The monitor shall be designed to operate from a 4-20 mA DC powered loop, 12 – 30V DC.
5. Manufacturer: GASMAX II Gas Monitor, or approved equal.

D. ORP SYSTEM

1. Provide complete Oxygen Reduction Potential (ORP) measurement systems, as shown on the drawings.
2. The monitor shall be constructed of chemical resistant materials, and FM rated for installation in Class 1 Div 2 locations, and intrinsically safe.
3. Manufacturer: Hach, Sensorex, or approved equal.

E. ELECTROMAGNETIC FLOW METER

1. Provide and install magnetic flow meter(s) as shown on the Contract Drawings. The flow meter(s) shall be complete with all necessary accessories and hardware for a complete and workable installation.
2. General: The magnetic flow meters shall be of the low frequency and short form coil design. The field principle of electromagnetic induction shall produce a positive DC pulsed signal directly and linearly proportional to the liquid flow rate. The metering tube shall be constructed of carbon steel with ANSI flanged end connections. Electrodes shall be of 316 stainless steel, Hastelloy®, or zirconium construction. The material of construction of the liner shall be Hard Rubber. The meter shall secure its power from the signal converter. The systems shall have a power consumption of no more than 20 watts each. No electronics shall be mounted in the metering tube of the magnetic flow meter.
3. The signal converters shall be integral to the flow head. Signal converters shall provide a precisely adjusted direct current at a keyed pulse frequency of 15 Hz per second to the primary field coil. The signal converters shall convert the output signal from the flow meters into a 4-20 mA signal directly proportional to flow rate. The signal converters shall have automatic zero correction. The accuracy shall be ± 0.5 percent of the actual flow rate. The signal converters shall transmit an isolated analog 4-20 mA D-C signal, directly proportional to flow and a totalizer contact for remote flow totalization. The signal converters shall be designed to operate from a 120 ac, 60 Hz, single phase, power source. The signal converters shall generate power for the magmeter.
4. The magnetic flow meter enclosure shall be NEMA 4X classified. The units shall be labeled and listed by a recognized electrical testing laboratory for the application, or Approved by the Washington State Department of Labor and Industries for installation on the Project.
5. Each meter system shall be wet-calibrated at the manufacturer's facility against the master system. A calibration certificate shall be furnished for each meter. Provide

grounding rings with each flow meter. Provide factory electrode and other cabling as required by the manufacturer.

6. The magnetic flow meters and signal converters shall include the following minimum components:
 - a. Transmitter, Remote Mount.
 - b. Ethernet communications module.
 - c. Mag Flow Meter.
 - d. Standard Coil Cable.
 - e. Standard Electrode Cable.
 - f. Remote Mount Wall Bracket.
 - g. Submersible Kit.
 - h. Grounding rings.
7. Manufacturer shall be Endress-Hausser Proline Promag L400 series.

F. FLOAT SWITCH

1. Switch shall be free floating, bulb shaped type suspended on a cable from a Kellems cord grip/strain relief. The float cable shall be a PVC coated multicore connecting cable which also contains the conductors. Float shall contain one non-mercury snap action switch.
2. Float switches in classified areas shall be provided with intrinsic safety barriers.
3. Level switch shall be Anchor Scientific Rotofloat, Siemens, or Engineer approved equal.

G. SEAL FAIL AND THERMAL RELAYS

1. Pump seal fail and thermal relays shall be installed for each submersible pump in the system. The relay shall be capable of connecting to a seal failure probe and thermal contacts in the pump housing, and shall have output contacts to energize external indicator lights.
2. It is the responsibility of the pump control panel manufacturer to select and coordinate the relays with the pump equipment provider for compatibility.

2.04 CONTROL PANELS:

Control panels shall be designed, assembled, tested and placed into operation by the System Integrator. The control panel shall fit into the space requirements as shown on the drawings. The contract drawings show general control panel layout and space requirements. Final dimensions shall be selected by the System Integrator to adequately install and wire the required control equipment. Detailed panel layout and interconnecting drawings shall be submitted prior to ordering of materials, and shall be subject to review and approval by the Engineer.

Material shall be new, free from defects, and of the quality specified. Similar items in the system shall be the products of the same Manufacturer. All equipment shall be of industrial grade and of standard construction, shall be capable of long, reliable, trouble-free service, and shall be specifically intended for control and monitoring industrial equipment.

A. Indoor Control Panels

Cabinet shall be a NEMA 250, Type 12 enclosure, with back panel. Cabinet shall be fabricated from 16 ga. minimum thickness sheet steel, and shall be ANSI 61 gray standard phosphate finish. Panel interiors and back panels shall be white. Cabinet shall be provided with an interior frame or otherwise formed so as to provide a rigid structure. Three-point latch hardware shall be provided for doors exceeding 30 inches high. Hoffman Concept series, or equal.

The panel shall include padlocking quick release L-handles to allow the panel to be opened without the use of tools. Hoffman, Hammond, or equal.

B. Outdoor Control Panel

Cabinet shall comply with NEMA 250, Type 4X requirements as shown on the drawings and to meet the control equipment manufacturers' environmental requirements. The panel shall be fabricated from Type 316 Stainless Steel, and shall include a hidden hinge and back panel for equipment mounting. Hoffman, Hammond, or equal.

Panels that are mounted outdoors shall be provided with a sun shield, or with a ventilation/cooling system to maintain the internal temperature of the panel interior within the equipment ratings at typical ambient temperatures for the installation conditions. Panel fans and/or ventilation systems shall be thermostatically controlled.

The panel shall include thru the door main disconnect and padlocking quick release L-handles to allow the panel to be opened without the use of tools. Hoffman #ELHP, or equal.

2.05 OPERATING AND INDICATING DEVICES:

Operating and indicating devices minimum rating shall be NEMA 13. Operator devices mounted in outdoor panels, corrosive areas or where exposed to moisture shall be NEMA 4X.

1. Selector Switches

Selector switches shall be for use on 120 volt control circuits. Contacts shall have a continuous current rating of 10 amperes both inductive and resistive. Selector switches shall be of the heavy duty oil tight type. Allen Bradley, Bulletin 800T, 800H, or equal.

2. Push buttons

Push buttons and illuminated push buttons shall be for use on 120 volt control circuits and shall have continuous current rating of 10 amperes both inductive and resistive. Pushbuttons for "E-STOP" or emergency applications shall have maintained contacts and red mushroom head operators. Allen Bradley, Bulletin 800T, 800H, or equal.

3. Indicating Lights

Indicating lights shall be push-to-test oil tight type. Units shall have LED lamps and shall be of the illuminated pushbutton type with the pushbutton wired for the push-to-test function required. Appropriate LED and lens color shall be provided as shown. Allen Bradley, Bulletin 800T, 800H, or equal.

4. Run Time Meters

Run time meter (elapsed time meters) shall be 2" X 1" nominal size, rectangular case type for flush panel mounting. The meter face shall be of the style that most closely resembles the Control Panel indicating instruments. The meters shall have a 6-digit non-resettable register with the last digit indicating tenths of an hour.

5. Control Relays

Relays for general purpose use shall be DPDT, 5 ampere minimum contacts with the appropriate coil voltage for the application. They shall have an 8-pin base, matching socket, and contact status indicator. All relays shall include MOV snubbers (for AC) or diodes (for DC) applied across the relay coils to reduce the surge caused by coil breakdown transients. Relays shall be Idec RH2B-ULD, or equal.

6. Terminal Blocks

Terminal blocks shall be 600 volt modular terminal blocks with tubular screw and pressure plate. Provide a minimum of 20% or four whichever is greater, spare terminals in each panel. Allen-Bradley #1492-CA1, or equal.

2.06 PLC HARDWARE AND SUPPORT EQUIPMENT:

A. PLC HARDWARE

A complete PLC system shall be provided with the logic and communications capabilities as shown on the drawings and in these specifications. A minimum of 20% spare I/O shall be provided. PLC shall be Allen Bradley 1756 ControlLogix series. The control system integrator shall provide a complete PLC system to provide the functions described in this specification, and shall include the parts and quantities shown on the drawings, or as required for a complete and operational system.

The basis of design for the PLC panel shall include:

1. Processor: ControlLogix #1756-L82E ControlLogix 5580 controller with 5 MB user memory, USB, 1 GB Ethernet port, 175 IP devices, 4 character alphanumeric display.
2. Power supply: 1756-PA series, sized to meet system requirements. 85-265V AC power input, 5 VDC output.
3. Chassis: #1756-A series, quantity and slots to meet I/O requirements and available panel space.
4. Discrete input cards: #1756-IA16 79-132 VAC input cards, 16 point.
5. Discrete output cards: #1756-OA16 79-132 VAC output cards, 16 point.
6. Analog input cards: #1756-IF16 analog input card, 16 point.
7. Analog output cards: #1756-OF8I analog output card, 8 point, individually isolated.
8. Other miscellaneous hardware and accessories for a complete and operational PLC system.

B. PROGRAMMING OF PLC

The PLC shall be initially programmed by the Contractor for general I/O and communications configuration. Functional PLC and operator interface programming will be completed by the Programmer. The Contractor shall provide field technicians to assist with the startup and functional checkout of the complete PLC and control system.

C. NETWORK SWITCHES

The network switches shall be Allen Bradley Stratix series, or equal.

D. FIBER OPTIC COMMUNICATIONS EQUIPMENT

The Fiber optic system shall include fiber optic cables, patch panels, patch cables, connectors, SFP adapters, installation and testing, and other parts and services shown on the drawings, or as required for a complete and operational system.

E. UNINTERRUPTIBLE POWER SUPPLIES (UPS)

UPS systems shall be provided for the PLC systems. The UPS systems shall be sized by the System Integrator for a minimum of 5 minutes of backup at full load.

Eaton 9SX series industrial grade with internal bypass, or equal.

F. PLC AND OPERATOR INTERFACE PROGRAMMING SOFTWARE

PLC programming software shall be provided by the Owner to allow configuration and programming of the new Control Logix PLC system.

G. SCADA COMPUTERS AND SOFTWARE

SCADA programming software and computers shall be provided by the Owner to allow configuration and programming of the existing Wonderware SCADA system.

3.00 EXECUTION

3.01 GENERAL:

- A. Install materials and equipment in a workman-like manner utilizing craftsmen skilled in the particular trade. Provide work which has a neat and finished appearance.
- B. Coordinate Instrumentation and Control work with the System Integrator, Owner, Contractor and work of other trades to avoid conflicts, errors, delays and unnecessary interference with system operations during construction.

3.02 COORDINATION WITH SYSTEM INTEGRATOR:

- A. The Contractor shall coordinate directly with the System Integrator to ensure all requirements within the scope of this Section are satisfied.
- B. System Simulation
To the degree possible, the entire control and communications systems shall be simulated at the System Integrator's facility by the Engineer. The Control System integrator shall provide shop facilities, power, setup and wiring of the simulated system for the use of the Engineer for programming and testing.

3.03 PROTECTION DURING CONSTRUCTION:

The Contractor shall provide protection for materials and equipment against loss or damage and the effects of weather. Prior to installation, store items in an indoor, dry location. Provide heating in

storage areas for items subject to corrosion under damp conditions. Specific storage requirements shall be in accordance with the manufacturer's recommendations.

3.04 MATERIAL AND EQUIPMENT INSTALLATION:

Follow manufacturer's installation requirements, unless otherwise indicated. Wherever any conflict arises between manufacturer's instructions and these Contract Documents, follow Engineer's decision, at no additional cost to the Owner. Maintain a copy of manufacturer's installation instructions on the jobsite at all times.

3.05 SYSTEM STARTUP AND TESTING:

- A. The control system shall be put into operation by the System Integrator, Electrical Contractor, and Programmer. The functionality of all aspects of the system shall be verified at this time. The Contractor will provide all labor and services for a complete installation, based on the schedule determined by the Engineer and Owner.
- B. A witnessed functional acceptance test shall be performed on the completed control system. Each feature and function shall be demonstrated to the satisfaction of the Engineer. The actual testing program shall be conducted in accordance with the prior approved procedures, and shall be witnessed and signed off by both the Contractor and the Engineer upon satisfactory completion.
- C. All special testing materials and equipment required to demonstrate compliance with the specification shall be provided by under the scope of this Section. Where it is not practical to test with real process variables, provide suitable means of simulation. These simulation techniques shall be subject to the approval of the Engineer.
- D. Coordinate all testing with other associated suppliers and subcontractors.
- E. Complete operational training shall be provided by the Contractor and System Integrator for operation and maintenance procedures.

****END OF SECTION****

.00 GENERAL

1.01 SECTION INCLUDES:

A. Material and installation requirements for:

1. Variable frequency drives
2. Harmonic mitigation equipment

1.02 DESCRIPTION OF WORK

A. This section covers furnishing and installing variable frequency drives.

1.03 RELATED SECTIONS:

A. Related Sections include but are not necessarily limited to:

1. Section 26 60 00 – Electrical General Provisions
2. Section 26 60 02 – Basic Materials and Methods
3. Section 26 05 19 – Wire and Cable
4. Section 26 05 33 – Raceways
5. Section 26 90 20 – Motor Control Centers
6. Section 26 90 22 – Pump Control Panel

1.04 STANDARDS AND REFERENCES:

- A. All materials and equipment specified herein shall within the scope of UL Examination Services, be approved by the Underwriter's Laboratories for the purpose for which they are used and shall bear the UL label.
- B. All materials and equipment specified herein shall conform with all applicable NEMA, ANSI and IEEE Standards
- C. All materials and equipment specified herein and their installation methods shall conform to the latest published version of the National Electrical Code, NEC.
- D. Manufacturer shall be ISO 9000, 9001, or 9002 certified.
- E. Installations shall be IEEE 519-2014 compliant.

1.05 SUBMITTALS:

A. Shop Drawings

1. See Section 26 60 00.

B. Submittals shall include the following information:

1. Outline Dimensions plus exterior and interior equipment elevation drawings.
2. Wiring diagrams with all interface points and terminal numbers clearly identified.

3. Specific information on the VFDs components provided for this project and all optional equipment provided.
4. Operations and programming manual.
5. Maximum watt dissipated at nominal current for each VFD.
6. Compliance to IEEE 519 - Harmonic analysis for particular jobsite including total voltage harmonic distortion and total distortion.
7. The VFD manufacturer shall provide calculations, specific to this installation, showing total harmonic voltage distortion is less than 5%. Input line filters shall be sized and provided as required by the VFD manufacturer to ensure compliance with IEEE standard 519-2014, Guide for Harmonic Control and Reactive Compensation for Static Power Converters. The acceptance of this calculation must be completed prior to VFD installation.
8. Prior to installation, the VFD manufacturer shall provide the estimated total harmonic distortion (THD) caused by the VFDs. The results shall be based on a computer aided circuit simulation based on the rating of the transformer supplying the VFDs.
9. If the field measured voltage THD exceeds 5%, the VFD manufacturer is to required to provide, at no additional cost, the additional equipment required to reduce the voltage THD to an acceptable level. Field measurements shall be performed per IEEE 519-2014 requirements; coordinate with utility as required.
10. The actual voltage THD shall be tested by an independent test agency, contracted by the supplier. This test shall be witnessed by the Engineer. If remedial action is required, the distortion must be tested again until the levels satisfy the specifications.
11. Installation requirements for elimination of interference on signal and control wiring, such as: minimum of conductors, providing shielded wire, metallic raceways, etc.
12. Additional equipment requirements for elimination of interference on signal and control wiring, such as: filtering, line terminators, reactors, etc.

1.06 COORDINATION:

- A. Coordinate and assist the Control System Integrator in Section 26 90 21 and the Membrane Filtration System Seller to provide a functioning system for each VFD including:
 1. Wiring checkout to/from remote PLCs as shown on the bucket wiring diagrams or OEM submittals.
 2. Wiring checkout from all field instruments, as shown on the bucket wiring diagrams or OEM submittal.
 3. 4-20ma scaling and calibration for the Speed Command and Speed Feedback signals.
 4. 4-20ma isolation.
 5. Minimum and maximum speeds dependent upon each application.

6. Parameter configuration for each I/O used at the VFD as determined by the wiring terminated at the VFD:
 - a. Remote Run Command, H-O-A switch on bucket door in “Auto” and Local H-O-R hand-switch in “Hand” or “Remote”.
 - i. Start Command issued from remote PLC contact.
 - ii. VFD modulates speed based upon 4-20ma Speed Command Signal from remote PLC.
 - b. Remote ‘HIM’ Run Command, H-O-A switch on bucket door in “Hand” and Local H-O-R hand-switch in “Remote”.
 - i. Start Command issued from the HMI on the bucket door.
 - ii. VFD modulates speed based upon the Speed Command issued from the HMI on the bucket door.
 - c. Enable Command – Drive not ENABLED (VFD power removed on the motor leads) - Enable Jumper removed. Software Enable/Disable is not permitted.
 - d. Stop Assertive – When this input is not powered the VFD will not start from any control source.
 - e. Comm. Fault Action – Hold Last State,
 - f. VFD Running – Contact closure at the VFD for status to a remote PLC and a local indicating RUN light on the bucket door.
 - g. VFD Faulted – Contact closure at the VFD for status to a remote PLC.
 - h. Miscellaneous faults affecting VFD operation, such as High Motor Temp, Motor Moisture Seal failure, etc – as shown on the drawings.
 - i. Speed Feedback to a remote PLC for all modes of operation.
- B. Coordinate the installation of the VFDs into the space provided and shown for them in the plans. Provide all additional equipment necessary for mounting and connection of all features and coordinate for the necessary space. If additional equipment is necessary for the proper operation of the VFDs including equipment for reducing the harmonic distortion and limit voltage reflections at the motor; it is the contractors and manufacturers responsibility to coordinate mounting and providing necessary space for this equipment.

1.07 WARRANTY:

- A. Warranty shall be 24 months from the date of certified start-up, not to exceed 30 months from the date of shipment. The warranty shall include all parts, labor, travel time, and expenses.

1.08 DELIVERY, STORAGE, AND HANDLING:

- A. See Section 26 60 00.

2.00 PRODUCTS

2.01 GENERAL:

- A. Provide variable frequency drives (VFDs) to control the speed of variable torque or constant torque loads with horsepower ratings as indicated on the drawings.
- B. The variable frequency drive (VFDs) motor controller shall convert 460 volt, three-phase, 60 Hertz utility power to adjustable voltage (0-460v) and frequency (0 - 120hz) three-phase, AC power for stepless motor speed control with a capability of 10:1 speed range. All general options and modifications shall mount within the standard adjustable frequency controller enclosure.
- C. The adjustable frequency drives (VFDs) shall be solid state, with a Pulse Width Modulated (PWM) output wave form (VVI, six-step, and current source drives are not acceptable). The VFD package as specified herein shall be completely assembled and tested by the manufacturer. The VFD shall employ a full wave rectifier (to prevent input line notching), DC Line Reactor, capacitors, and Insulated Gate Bipolar Transistors (IGBTs) as the output switching device (SCRs, GTOs and Darlington transistors are not acceptable). The drive efficiency shall be 97% or better at full speed and full load. Fundamental power factor shall be 0.95 or better at all speeds and loads.
- D. The controller(s) shall be suitable for use with any standard NEMA-B squirrel-cage induction motor(s) having a 1.15 Service Factor or with existing standard NEMA-B squirrel-cage induction motor(s) with nameplate data as shown on the plans. At any time in the future, it shall be possible to substitute any standard motor (equivalent horsepower, voltage and RPM) in the field.
- E. The VFD output to the motor shall have a dV/dT no greater than 1100 volts per 1 second.
- F. The variable frequency control shall operate satisfactorily when connected to a bus supplying other solid state power conversion equipment which may be causing up to 10% total harmonic voltage distortion and commutation notches up to 36,500 volt microseconds, or when other VFDs are operated from the same bus.
- G. The variable frequency control shall include transient voltage suppression to allow reliable operation on a typical industrial or commercial power distribution system.

2.02 SIZE AND QUANTITY:

- A. Drives shall be of the size, capacity and quantity as shown on the one line diagram accompanying this specification.

2.03 BASIC FEATURES:

- A. The Contractor shall coordinate between the VFD and motor manufacturers to provide a motor/VFD combination suitable for the application. Any line terminators, filtering devices, harmonic filters, line reactors, or other devices required for proper operation of the motor/VFD combination shall be provided and installed by the Contractor at no extra cost to the Owner.
- B. All VFDs shall have the following standard features
 - 1. The enclosure door of each VFD unit shall include a "POWER ON" light, a VFD fault light, a VFD run light, a "HAND-OFF-AUTOMATIC" selector switch, operator interface keypad and display unit.
 - 2. VFD speed shall be adjustable via the following separate inputs:

3. Keypad.
4. Two Analog inputs, each capable of accepting a 0-20mA, 4-20mA, 0-10V, 2-10V signal. Input shall be isolated from ground, and programmable via the keypad for different uses.
5. Analog inputs shall have a filter to remove any oscillation of the reference signal. The analog input should be able to be inverted, so that minimum reference corresponds to maximum speed, and maximum reference corresponds to minimum speed. The minimum and maximum values (gain and offset) shall be adjustable within the range of 0-20mA and 0-10 Volts.
6. All VFDs shall have the same customer interface, including digital display, keypad and customer connections; regardless of horsepower rating. The keypad is to be used for local control (start/stop, forward/reverse, and speed adjust), for setting all parameters, and for stepping through the displays and menus.
7. The VFD shall be selectable to provide automatic restart after a trip condition resulting from overcurrent, overvoltage, undervoltage, or over-temperature. For safety, the drive shall shut down and require manual reset and restart if the automatic reset/restart function is not successful within a maximum of three attempts within a short time period.
8. The manufacturer shall provide each Drive with the necessary equipment to limit the total harmonic voltage distortion THD to 5% at the point of common coupling. The THD shall be measured in accordance with IEEE 519-2014 and based on a supply source which can deliver 36,000 AIC. It is acceptable to measure the THD on the secondary side of the transformer.
9. Automatic restart after utility failure. Software selectable if not desired.
10. The VFD shall give the user the option of either (1) displaying a fault, or (2) running at a programmable preset speed if the input reference (4-20mA or 2-10V) is lost; as selected by the user.
11. The VFDs shall utilize plain English digital display (code numbers are not acceptable). All set-up parameters, indications, faults, warnings and other information must be displayed in words to allow the user to understand what is being displayed without the use of a manual or cross-reference table.
12. If available, the VFDs shall utilize pre-programmed application macro's specifically designed to facilitate start-up. The Application Macros shall provide one command to reprogram all parameters and customer interfaces for a particular application to reduce programming time.
13. The inverter output shall be generated by power transistors which shall be controlled by six identical base driver circuits. The VFD shall not induce excessive power losses in the motor. The worst case RMS motor line current measured at rated speed, torque and voltage shall not exceed 1.05 times the rated RMS motor current for pure sine wave operation.
14. The VFD shall have DC Link Choke or equal to reduce the harmonics to the power line.
15. Frequency resolution and accuracy shall be minimum 0.5%.

16. The VFD shall be optimized for a 3 kHz carrier frequency. The carrier frequency shall be adjustable from 3-9kHz.

2.04 SERVICE CONDITIONS:

- A. The controller shall be designed and constructed to operate within the following service conditions:
 1. Elevation: To 3300 feet
 2. Ambient Temperature Range: 0°C to 40°C
 3. Atmosphere: Non-Condensing relative humidity to 95%
 4. AC Line Voltage Variation: -10% to +10%
 5. AC Line Frequency Variation: +3 Hertz

2.05 KEY PAD / DISPLAY UNIT:

- A. The VFD shall be supplied with a key pad unit for programming and changing parameters. The unit shall have a keypad and digital display. The unit shall be mounted on the MCC or control panel door and be accessible without opening the enclosure door. The following operating adjustments and information shall be standard on the VFD control pad. The display shall be in complete English words (alpha-numeric codes are not acceptable):
 1. Display
 - a. Output Frequency
 - b. Motor Speed (RPM, % or Engineering units)
 - c. Motor Current
 - d. Calculated Motor Torque
 - e. Calculated Motor Power
 - f. DC Bus Voltage
 - g. Output Voltage
 - h. Analog Input Values
 - i. Elapsed Time Meter
 - j. kWh meter
 - k. Control Mode: Manual or Automatic
 - l. Adjustments
- B. The controller shall have the following adjustments accessible through the control pad display unit:
 1. Control mode: Manual or Automatic

2. Maximum Frequency: 60, 90 or 120 Hz.
 3. Speed: Frequency-Max., Frequency-Min.
 4. Independent acceleration/deceleration rates: 2 - 120 seconds
 5. Voltage Parameters: V-min, V-max, V/Hz.
 6. Current Limit: 50 - 110% of drive rating
 7. Inverse time overload, limit, time
 8. Current Boost
 9. Speed shedding current limit
 10. Speed Profile: Entry, Exit, Min. Speed, Max. Speed
 11. Auto Start: delay on/off, on/off levels
 12. Inverse Profile
 13. Selectable follower/setpoint control
- C. All drive setting adjustments and operation parameters shall be stored in a parameter log which lists allowable maximum and minimum points as well as the current set values. This parameter log shall be accessible via a Ethernet port as well as on the keypad.
- 2.06 ENCLOSURE:
- A. All VFD components shall be factory mounted and wired in the motor control center or pump panel as shown on the plans. (see Section 26 90 20). Separate freestanding enclosures will not be accepted. It is the contractor's responsibility to coordinate the installation of the VFDs into the MCC to provide a complete integrated system. The wiring and space requirements shall be met as shown on the plans. All accessory and related equipment for control and harmonic reduction shall also be mounted within the VFD enclosure space as shown on the plans.
- 2.07 PROTECTIVE FEATURES AND CIRCUITS:
- A. The VFD shall have the following protection circuits. In the case of a protective trip, the drive shall stop, and announce the fault condition in complete words (alpha-numeric codes are not acceptable).
1. Overcurrent trip 315% instantaneous (225% RMS) of the VFDs variable torque current rating.
 2. Overvoltage trip 115% of the VFDs rated input voltage
 3. Undervoltage trip 70% of the VFDs rated input voltage
 4. Overtemperature +70 degrees C (ACS 501); +85 degrees C (ACS 502)
 5. Ground Fault either running or at start The VFD shall have the ability to automatically restart an overcurrent, overvoltage, undervoltage, or loss of input signal protective trip. The number of restart attempts, trial time, and time between reset attempts shall be programmable. If the time between reset attempts is greater than zero, the time

remaining until reset occurs shall count down on the display to warn an operator that a restart will occur.

6. Single phase fault or 3-phase fault short circuit on VFD output terminals without damage to any power component. The VFD shall be rated minimum 35kAIC or for the AIC as shown on the one-line.
 7. Static overspeed (overfrequency) protection
 8. LED monitor lamps for each inverter stage
 9. LED status indicators on regulator, printed circuit board face plates.
 10. Individual transistor overcurrent protection
 11. The VFD shall be capable of starting into a rotating load (forward or reverse) and accelerate or decelerate to setpoint without safety tripping or component damage (flying start).
 12. The VFD shall be equipped with an automatic extended power loss ride-through circuit which will utilize the inertia of the load to keep the drive powered. Minimum power loss ride-through shall be on-cycle, based on full load and no inertia. Removing power from the motor is not an acceptable method of increasing power loss ride-through.
 13. The customer terminal strip shall be isolated from the line and ground.
 14. The drive shall employ three current limit circuit to provide trip free operation:
 15. The Slow Current Regulation limit circuit shall be adjustable to 125% (minimum) of the VFDs variable torque current rating. This adjustment shall be made via the keypad, and shall be displayed in actual amps, and not as percent of full load.
 16. The Rapid Current Regulation limit shall be adjustable to 170% (minimum) of the VFDs variable torque current rating.
 17. The Current Switch-off limit shall be fixed at 255% (minimum, instantaneous) of the VFDs variable torque current rating.
 18. The overload rating of the drive shall be 110% of its variable torque current rating for 1 minute every 10 minutes, and 140% of its torque current rating for 2 seconds every 15 seconds.
 19. Adaptable Electronic Motor Overload (I2t). The electronic Motor Overload protection shall protect the motor based on speed, load curve, and external fan parameter, and shall be UL listed. (or by solid state adjustable overload relay).
 20. Provide programmable carrier frequency and volts/hz.
 21. Provide 1 second minimum power ride through.
- B. The VFD shall have input line fuses installed in the drive enclosure.

2.08 DIAGNOSTIC FEATURES AND FAULT HANDLING:

- A. The following conditions shall cause a safe drive shutdown:

1. Loss of input power
2. Undervoltage
3. Sustained gradual overload
4. Instantaneous severe overload
5. Power transistor overtemperature
6. Blown fuse
7. Logic power supply failure

B. The VFD shall include a comprehensive microprocessor based digital diagnostic system which monitors its own control functions and displays faults and operating conditions.

1. A "FAULT LOG" shall record the VFD operating mode, elapsed time, reset and mode or fault for the 8 most recent events.
2. A "HISTORIC LOG" shall record the actual drive control variables at 5 millisecond intervals for the 100 intervals immediately preceding a fault trip accessible through RS232 port.
3. Fault log record shall be accessible via an Ethernet link as well as line by line on the keypad display.

2.09 DRIVE OPTIONS:

A. Provide all necessary options for the drives to meet the power and control functions as shown and implied by the plans, specifications and programming statements and to meet the requirements of the total power and control system including the following: All options shall be factory mounted and wired within the VFD enclosure unless otherwise specified.

1. (3) programmable critical frequency lockout ranges to prevent the VFD from continuously operating at an adjustable speed.
2. PI Setpoint controller allowing a pressure or flow signal to be connected to the VFD, using the microprocessor in the VFD for the closed loop control; thus eliminating the need for external controllers.
3. Two (2) programmable analog inputs shall accept a current or voltage signal for speed reference, or for reference and actual signals for PI controller. Analog inputs shall include a filter to remove any oscillation in the input signal. The minimum and maximum values (gain and offset) shall be adjustable within the range of 0-20 mA and 0-10 Volts. Additionally, the reference must be able to be scaled so that maximum reference can represent a frequency less than 60 Hz, without lowering the drive maximum frequency below 60 Hz.
4. Six (6) programmable digital inputs for maximum flexibility in interfacing with external devices.

5. Two (2) programmable analog outputs proportional to Frequency, Motor Speed, Output Voltage, Output Current, Motor Torque, Motor Power, DC Bus voltage, or Active, or Active Reference.
6. Three (3) programmable digital relay outputs. The relays shall be rated for maximum switching current 8 amps at 24 VDC and 0.4 amps at 250 VAC; Maximum voltage 300 VDC and 250 VAC; Continuous current rating 2 amps RMS. Outputs must be true form C type contacts; open collector outputs are not acceptable.
7. Seven (7) programmable preset speeds.
8. Two independently adjustable accel. and decel. ramps. These ramp times shall be adjustable from 1 to 120 seconds.
9. The VFD shall Ramp or Coast to a stop, as selected by the user. Serial Communications
10. The VFD shall have an Ethernet port as standard.
11. The VFD shall be able to communicate with PLC's, DCS's, DDC's, and touch-screen graphic operator panels.
12. Accessories to be furnished and mounted by the drive manufacturer.
13. Customer Interlock Terminal Strip - provide a separate terminal strip for connection of freeze, fire, smoke contacts, and external start command. All external interlocks and start/stop contacts shall remain fully functional whether the drive is in Hand, Auto or Bypass.
14. All wires to be individually numbered at both ends for ease of troubleshooting.
15. Door interlocked thermal magnetic circuit breaker which will disconnect all input power from the drive and all internally mounted options. the disconnect handle shall be thru-the-door type, and be padlockable in the "Off" position.

2.10 SYSTEM OPERATION:

- A. Provide all necessary components, inputs, outputs, and options such that the VFD will operate according to the following:
 1. With the H-O-A switch in the "HAND" position, the drive shall be controlled by the door mounted keypad..
 2. With the H-O-A switch in "AUTOMATIC", the drive shall start when the PLC calls, and its speed shall be controlled by an isolated 4-20mA (or 0-10VDC) signal from the PLC.
 3. With the H-O-A switch in the "OFF" position, the run circuit will be open and the VFD will not operate.

2.11 QUALITY ASSURANCE AND FACTORY TESTS:

- A. The controller shall be subject to, but not limited to, the following quality assurance controls, procedures and tests:

1. Power transistors, SCRs and diodes shall be tested to ensure correct function and highest reliability.
2. All printed circuit boards shall be tested at 50°C for 50 hours. The VFD manufacturer shall provide certification that the tests have been completed.
3. Every controller will be functionally tested with a motor to ensure the drive is operating per the performance requirements and design intent.

2.12 ACCEPTABLE MANUFACTURERS:

- A. The VFDs for this project were designed around the features of Eaton SVX 9000 series.
- B. Acceptable manufacturers shall provide equipment which meets all of the requirements of these specifications, and fit within the space requirements. Acceptable manufacturers shall have 3 installations of VFDs in Eastern Washington, and shall be chosen from the list below:
 1. Eaton SVX 9000, no equal.

2.13 HARMONIC MITIGATION EQUIPMENT

- A. Input Line Reactors: Line reactors shall be 3% impedance and shall be size appropriately for application. Transcoil International, Inc., or approved equal.
- B. Output DV/DT Reactors: Reactors shall provide motor protection and shall be size appropriately for application. Transcoil International, Inc., or approved equal.

3.00 EXECUTION

3.01 INSTALLATION:

- A. Installation shall be the responsibility of the Contractor. The Contractor shall install the drive in accordance with the contract drawings and as recommendations of the System Integrator and VFD manufacturer as outlined in the installation manual.
- B. Power and control wiring shall be completed by the electrical Contractor. The Contractor shall complete all wiring in accordance with the recommendations of the System Integrator and VFD manufacturer as outlined in the installation manual.
- C. VFD's shall be provided with harmonic correction as necessary to reduce line harmonics to an acceptable level. VFD's shall be provided with output reactors or line terminators to reduce the voltage reflections at the motor. The Contractor shall coordinate installation of VFD's with the VFD manufacturer and motor manufacturer to provide any necessary voltage reflection reducing equipment. The motor ratings and lead length shall be taken into consideration. Equipment shall be provided at no additional cost.
 1. The Contractor shall be responsible to provide space for any additional harmonic correction or line noise correction equipment.
- D. VFD carrier frequency shall be set no higher than 3 kHz.

3.02 START-UP:

- A. Certified factory start-up shall be provided for each drive by a factory authorized service center. A certified start-up form shall be filled out for each drive with a copy provided to the Engineer, Owner, and a copy kept on file at the manufacturer. Cost for this startup support shall be included in the VFD bid price. The Engineer shall be notified a minimum 1 week in advance of the scheduled start-up.

3.03 OPERATION AND MAINTENANCE TRAINING:

- A. The Supplier shall conduct specifically organized training sessions in operation and maintenance of the VFD equipment for personnel employed by the Owner. The training sessions shall be conducted to educate and train the personnel in maintenance and operation of all components of the system. Training shall include, but not be limited to, the following:
1. Preventative maintenance procedures
 2. Trouble-shooting
 3. Calibration
 4. Testing
 5. Replacement of components.
- B. At least (1) training session, of at least (4) hours in duration, shall be conducted after start-up of the system. The Supplier shall provide specific instruction materials for each training session and shall supply such materials to the Owner at least two (2) weeks prior to the time of the training.

****END OF SECTION****

1.00 GENERAL

1.01 SECTION INCLUDES:

A. Material and installation requirements for:

1. Solid State Motor Starters

1.02 DESCRIPTION OF WORK:

A. This section covers furnishing and installing solid state motor controller units, hereafter referred to as SSS. The SSS shall provide a soft start and stop of the motors shown to decrease starting current and shall be designed to eliminate hydraulic shock on both starting and stopping.

1.03 RELATED SECTIONS:

A. Related Sections include but are not necessarily limited to:

1. Section 26 60 00 – Electrical General Provisions
2. Section 26 60 02 – Basic Materials and Methods
3. Section 26 05 19 – Wire and Cable
4. Section 26 05 33 – Raceways
5. Section 26 90 20 – Motor Control Centers
6. Section 26 90 22 – Pump Control Panel

1.04 STANDARDS AND REFERENCES:

- A. All materials and equipment specified herein shall within the scope of UL Examination Services, be approved by the Underwriter's Laboratories for the purpose for which they are used and shall bear the UL label.
- B. All materials and equipment specified herein shall conform with all applicable NEMA, ANSI and IEEE Standards
- C. All materials and equipment specified herein and their installation methods shall conform to the latest published version of the National Electrical Code, NEC.

1.05 SUBMITTALS:

A. Shop Drawings

1. See Section 26 60 00.

B. Submit catalog data showing material information, performance data, and physical dimensions conformance with specifications. Include information of all options provided.

1. Outline Dimensions plus exterior and interior equipment elevation drawings.
2. Wiring diagrams with details specific to this project showing all interface points and terminal numbers clearly identified.

3. Specific information on the VFDs components provided for this project and all optional equipment provided.
4. Operations and programming/adjustments manual.
5. Provide specific detailed information on the control features, their ranges, recommended set points etc.
6. Submit a written confirmation that the solid state starters provided will meet the written performance as described in this specification.

1.06 DELIVERY, STORAGE, AND HANDLING:

- A. See Section 26 60 00.

2.00 PRODUCTS

2.01 GENERAL:

- A. The SSS shall be suitable for operation on 480 volts, 3 phase, 3 wire, 60 Hz. The unit shall be housed in the motor control center and shall meet the applicable requirements of Section 26 90 20.
- B. It is the manufacturer's responsibility to coordinate the installation of the SSS into the motor control center and be sure that the performance and space requirements are met.
- C. The solid state motor controller shall have two silicon controlled rectifiers (SCR) per phase in a reverse parallel configuration. The starter shall have its own control power transformer, logic boards, and heat sinks. Each unit shall be completely prewired with all control wiring numbered and terminated on terminal strips.

2.02 OPERATIONAL REQUIREMENTS:

- A. The SSS shall be rated for continuous operation.
- B. The SSS shall function properly with input voltage variations of +10% and an input frequency variation of +3%. The unit shall be rated for operating within ambient temperatures of 0-50oC (32o - 122oF), 5 to 95% relative humidity (non-condensing). Unit shall be fully rated to an elevation of 3000 feet above sea level.

2.03 SCR REQUIREMENTS:

- A. The SCRs shall be assembled in pairs on power poles with fan forced cooling and so that a single pole may be replaced independently. The SCRs shall have overload ratings of:
 1. Continuously @ 115% of FLA @ 50°C ambient
 2. 30 seconds @ 300% of FLA @ 50°C ambient
 3. 10 seconds @ 600% of FLA @ 50°C ambient
- B. The SCR shall be 98% efficient or better. Each SCR shall be rated to block 2.5 times the normal line to line voltage, or 1200 volts minimum repetitive peak inverse voltage, PIV.

- C. SCRs shall be protected with metal oxide varistors (MOV) across the SCR pairs and rated to clamp transient voltages to 10% below the rated blocking voltage of the SCR. The energy absorbing capability shall be a minimum of 100 joules. Resistor/capacitor snubbers shall be employed to prevent false firing.

2.04 CONTROLS AND PERFORMANCE:

- A. Electronic controls for the SSS shall accomplish soft starting and stopping of the pump without hydraulic shocks to the piping system of the motor(s) indicated on the one-line. The gate drive circuit shall be optically coupled for noise immunity and long life.
- B. The starting ramp shall have all necessary dwell times, voltage boost, and ramps so that the pumps can be brought up to system pressure and accelerate up to full speed pumping into the system so that there will be no system disturbances.
- C. The SSS shall be capable of starting the load and maintain a maximum of 50% of rated starting current.
- D. Ramp times shall be separately adjustable for starting and stopping from 0 to 30 seconds.
- E. The stopping ramp shall have all capabilities mentioned for starting ramp separately adjustable. The stopping ramp shall reduce the pumping flow to zero while maintaining system pressure and holding at that speed for an adjustable time to allow check valve to close smoothly. Then continue to ramp down and stop the motor. Starting and stopping ramp times shall be separately adjustable. Allen Bradley pump control or equal.
- F. A motor voltage regulator adjustment shall be supplied to prevent higher than motor nameplate voltage from being applied to the motor when higher line voltages are present. An energy saving/power factor circuit shall be supplied if available. The device shall be phase rotation sensitive. A shorted SCR detector shall be supplied with an interlock contact that will prevent starting of a device with shorted SCRs, with alarm contacts.
- G. Terminals shall be provided in accordance with the wiring diagram shown on drawings which shall include:
 - 1. Call to run and stop.
 - 2. Remote signals for run and failure status.

2.05 OVERLOADS:

- A. If internal electronic overload relays are not supplied integral to the SSS, provide overload relays as follows.
- B. Overload relays shall be setpoint adjustable with selector for either auto or manual reset and a test button to simulate an overload. Provide a normally open contact from the relay for alarm or control use.

2.06 PROTECTION AND INDICATION:

- A. The SSS shall have protection and indication as detailed below.
 - 1. Provide starting and running fault protection to shutdown or inhibit starting on:

- a. start fault
 - b. phase loss
 - c. line fault
 - d. motor overload protection
 - e. temperature fault
 - f. shorted SCR
 - g. stalled motor
2. Provide indicating lights for the above faults and below status.
- a. control voltage present
 - b. starting
 - c. stopping
 - d. running
 - e. fail
3. Provide in-line power fuses for overcurrent protection of the SSS; with blown fuse indicators. Fuses shall be as recommended by starter manufacturer for the motor specified. Provide one set of spare fuses for each starter.

2.07 COOLING:

- A. Cooling fans shall be ball bearing type with interval impedance protection for the motor. Supply an over temperature sensor with a normally closed contact.

2.08 TERMINALS:

- A. Line and load terminals shall be arranged for entry (top, bottom) in coordination with the design. Provide terminals and space for all field wiring. See Section 26 05 19 for terminal and wiring requirements.

2.09 LABELING/NAMEPLATES:

- A. Provide phenolic labels on all interior and exterior equipment see also Section 26 60 00.

2.10 ACCEPTABLE MANUFACTURERS:

- A. The Solid state starters shall be manufactured by one of the following acceptable manufacturers:
1. ALLEN BRADLEY, no equal.

3.00 EXECUTION

3.01 INSTALLATION:

- A. The solid state starter equipment shall be mounted in the motor control center by the motor control manufacturer.

3.02 SOLID STATE STARTER CONTROL:

- A. The solid state starter shall be wired such that normal operation of the pump is by the variable frequency drive and bypass operation is by the SSS. The solid state starter shall be wired such that if there is an overload, motor overtemp, or Emergency stop activated, the starter shall stop immediately and shall not “ramp down”.
- B. The solid state starter shall automatically restart after a utility power or phase fail.

3.03 INSPECTION AND STARTUP:

- A. The solid state starter as a component of the motor control center shall be tested in the manufacturers’s shop. All operations shall be simulated including ramp up, ramp down, switch to bypass, and immediate stop in the case of overload, motor overtemp, or e-stop.
- B. The field installation and wiring of the SSS equipment shall be inspected by the Supplier prior to initial operation. The SSS equipment shall be put into operation by the Control System Integrator. Cost for this startup support shall be included in the SSS bid price.

3.04 OPERATION AND MAINTENANCE TRAINING:

- A. The Supplier shall conduct specifically organized training sessions in operation and maintenance of the SSS equipment for personnel employed by the Owner. The training sessions shall be conducted to educate and train the personnel in maintenance and operation of all components of the system. Training shall include, but not be limited to, the following:
 - 1. Preventative maintenance procedures
 - 2. Trouble-shooting
 - 3. Calibration
 - 4. Testing
 - 5. Replacement
- B. At least (1) training session, of at least (2) hours in duration, shall be conducted after start-up of the system. The Supplier shall prepare and assemble specific instruction materials for each training session and shall supply such materials to the Owner at least three (2) weeks prior to the time of the training.

****END OF SECTION****

1.00 GENERAL

1.01 SECTION INCLUDES:

A. Material and installation requirements for:

1. Motor Control Centers

1.02 DESCRIPTION OF WORK:

A. This section covers furnishing and installing motor control centers.

1.03 RELATED SECTIONS:

A Related Sections include but are not necessarily limited to:

1. Section 26 60 00 – Electrical General Provisions
2. Section 26 60 02 – Basic Materials and Methods
3. Section 26 05 19 – Wire and Cable
4. Section 26 05 26 – Grounding
5. Section 26 05 33 – Raceways
6. Section 26 90 10 – Variable Frequency Drives
7. Section 26 90 17 – Solid State Starter Equipment
8. Section 26 90 21 – Control System

1.04 STANDARDS AND REFERENCES:

A. All materials and equipment specified herein shall within the scope of UL Examination Services, be approved by the Underwriter's Laboratories for the purpose for which they are used and shall bear the UL label.

B. Products shall be designed, manufactured, tested, and installed in compliance with the following standards:

1. American National Standards Institute (ANSI):
 - a. C62.41, Guide for Surge Voltages in Low Voltage AC Power Circuits.
2. National Electrical Manufacturers Association (NEMA):
 - a. ICS 2, Industrial Control Devices, Controllers, and Assemblies.
 - b. 250, Enclosures for Electrical Equipment (1000 Volt Maximum).
3. Underwriters Laboratories, Inc. (UL):
 - a. 845, Electric Motor Control Centers.
 - b. 1449, Standard for Safety, Transient Voltage Surge Suppressors.

4. All materials and equipment specified herein and their installation methods shall conform to the latest published version of the National Electrical Code, NEC.

1.05 SUBMITTALS:

A. Shop Drawings

1. See Section 26 60 00.

B. The Control Systems Integrator shall work with the MCC manufacturer to develop and submit to the Engineer, through the Contractor, the following project data:

1. Itemized list of all MCC features and components.
2. List of all nameplates on the MCC units.
3. System wiring diagrams for each unit in the entire motor control center including but not limited to: all instruments, relays, starters, switches, lights, breakers terminals, etc. Indicate on submitted diagrams the terminals for remote devices as shown on the wiring diagrams in the contract drawings. Wire and terminal numbers shall be included on the schematic diagrams. Relay contacts shall be indicated for type and number available for each relay used.
4. Information on ratings and sizes of all equipment such as control transformers, fuses, breakers, etc. on the wiring diagrams for each bucket.
5. Shop Drawings shall be provided on 11" x 17" sheets maximum size, and shall be scaled using standard engineering or architectural scales.
6. Connection diagrams showing physical wiring layout for each unit.
7. Technical data sheets for all components with the complete part number of the component clearly designated with all required options as specified in PART 2.
8. Scaled elevation drawings of the entire motor control center (including switchboards and transfer switches) exterior and interior with all devices clearly labeled.
9. Scaled arrangement drawings of all panel front- and internal-mounted instruments, switches, devices, and equipment indicated. Show all mounting details required. Deviations from approved arrangements require resubmittal and approval prior to installation.
10. Bill of materials showing quantity, manufacturer, catalog number, and the supplier name and phone number for all components of the MCC.
11. Overload relay heater tables.

1.06 DELIVERY, STORAGE, AND HANDLING:

- A. See Section 26 60 00.

2.00 PRODUCTS

2.01 ACCEPTABLE PRODUCTS:

- A. The size of the MCC shown on the drawings is based on Allen-Bradley, no equal.
- 2.02 MOTOR CONTROL CENTER:
- A. General
1. The motor control center shall be designed, assembled, tested and placed into operation by the supplier. The motor control center must be sized to fit into the space requirements as shown on the drawings. The drawings show general MCC layout and space requirements and may be modified by the MCC manufacture if first approved by the Engineer.
- B. Structure
1. The MCC shall be NEMA 1 gasketed construction and consist of vertical sections that can be joined together to form a rigid free-standing, completely enclosed assembly.
 2. The vertical section shall be fabricated of bolted no. 14 gage steel minimum. Each section shall have flange formed doors and/or covers both front and rear. The door shall include provisions for padlocking all breakers in the open position.
- C. Arrangement
1. Motor control center sections shall have a minimum 72-inch working height to accommodate a minimum of six 12-inch compartments. Sections shall be 20 inches deep with a 90-inch height. Minimum width shall be 20 inches. Compartments shall have pan-type doors with quarter turn hold-down latches and neoprene gaskets. Doors for compartments with starter and feeder tap units shall be mechanically interlocked with the unit's disconnect device to prevent unintentional opening of the door while energized and unintentional application of power while the door is open.
 2. Starters and feeder tap units shall be draw-out plug-in construction with hardened, plated copper free-floating stabs, steel spring backups, and interference tabs which prevent door closure if unit is improperly installed. Units shall be latched to assure proper bus contact.
 3. Floor sills and lifting means shall be provided.
- D. Shipping Splits
1. Motor control centers shall be constructed with shipping splits such that not more than 2 – twenty inch wide sections are joined together without a shipping split.
 2. Provide shipping splits between any two sections which when joined together would create a section greater than 40" wide.
- E. Finish
1. Exterior and structure color shall be per manufacturers standard color scheme. Starter buckets interiors shall be white.
 2. All steel parts shall be provided with an acrylic baked enamel paint finish, except plated parts used for ground connections. Painted parts shall be primed with a zinc-phosphate primer or undergo a phosphatizing pre-paint treatment for rust resistance and paint bond. Paint shall be applied by electrostatic process and baked to a durable hard finish.

F. Wiring / Terminals

1. The motor control center shall be suitable for operation on 480Y/277 volts, four-wire, 60 hertz. Wiring shall be NEMA Class II, Type B. Each unit shall be completely prewired with all control wiring numbered and terminated on terminal strips. Terminal's numbering shall be coordinated between units such that like devices shall have the same terminal numbers. Wiring within one bucket shall be labeled with a basic wire numbering scheme. Field wiring, or wiring between buckets shall conform to the requirements of Section 26 05 19.
2. Provide a drawing pocket in each unit; provide an individual wiring diagram and arrangement diagram in each bucket
3. Provide a minimum of 5 spare terminals in each unit. No terminal strips are required for the load wiring, except units with circuit breakers only - 30 amps and smaller shall have load wiring terminals. Auxiliary components such as HOA selector switches, indicating lights and other indicating and/or recording devices shall be mounted on the compartment door or cover. All control power leads into and out of each unit shall pass through auxiliary contacts of the circuit breaker or be equipped with their own disconnecting device or disconnecting terminal strips, appropriately labeled. On non-plug-in (frame mounted) units, terminal blocks need not be pull-apart style. On plug-in units, control terminal blocks shall be pull-apart style.
4. On non-plug-in (frame mounted) units, terminal blocks need not be pull-apart style. On plug-in units, control terminal blocks shall be pull-apart style.
5. See also requirements of Section 26 05 19.

G. Documentation

1. Project specific wiring diagrams shall be provided inside each unit. The diagrams shall show the exact devices inside the unit and shall not be a generic diagram.

H. Wireways

1. Full height vertical wireway shall be provided in each MCC section that accepts modular plug-in units. The vertical wireway shall connect with both the top and bottom horizontal wireway. The vertical wireway shall be 4" for a 20" wide (9" for a 25") wide section with a separately hinged door. Structures that house a single, full section control unit are not required to have vertical wireways. Those control units must open directly into the motor control center horizontal wireways.

I. Bus

1. Horizontal bus shall be tin-plated copper, vertical bus shall be tin plated copper. Connections between vertical and horizontal power bus bars shall be made with 3/8-inch bolts and conical dished steel washers. Access for tightening these connections shall be from the front, without the need for tools on the rear of the connection.
2. Unless otherwise specified all sections shall contain horizontal and vertical busses. Each end of the line up shall be provided for connection of future sections.

3. Provide removable plates for future connection to the horizontal bus on each end of the line up.
4. Unless otherwise specified or required by the components installed, main horizontal bus shall be rated a minimum 400 amperes continuous, vertical bus shall be rated a minimum of 200 amperes continuous.
5. Where specified, a full capacity neutral bus shall be provided. Neutral bus shall be mounted in close proximity to and rated the same as main horizontal bus.
6. A 200 ampere minimum un-plated copper ground bus shall be provided the full length of the motor control center. Ground bus shall be located at the bottom of the motor control center and shall contain lugs to terminate, as a minimum, two (one at each end of ground bus) No. 4/0 AWG bare copper ground conductors.

2.03 OPERATING AND INDICATING DEVICES:

- A. Operating and indicating devices minimum rating shall be NEMA 13. Operator devices mounted in outdoor panels, corrosive areas or where exposed to moisture shall be NEMA 4X.
- B. Selector Switches
 1. Selector switches shall be for use on 120 volt control circuits. Contacts shall have a continuous current rating of 10 amperes both inductive and resistive. Selector switches shall be of the heavy duty oil tight type. Allen Bradley 800T, 800H, GE CR104P, Square D Type K or approved equal.
- C. Push buttons
 1. Push buttons and illuminated push buttons shall be for use on 120 volt control circuits. and shall have continuous current rating of 10 amperes both inductive and resistive. Pushbuttons for "emergency" "help" applications shall have maintained contacts and red mushroom head operators. Allen Bradley Bulletin 800T, 800H or approved equal.
- D. Indicating Lights
 1. Indicating lights shall be push-to-test oil tight type. Units for alternating current systems shall include a 120-6 volt transformer and 6-8 volt lamp and shall be of the illuminated pushbutton type with the pushbutton wired for the push-to-test function required. Appropriate lens caps shall be provided as shown. Lamps shall be provided for each unit installed. Allen Bradley Bulletin 800T, 800H or approved equal.
- E. Run Time Meters
 1. Run time meter (elapsed time meters) shall be 2" X 1" nominal size, rectangular case type for flush panel mounting. The meter face shall be of the style that most closely resembles the MCC indicating instruments. The meters shall have a 7-digit non-resettable register with the last digit indicating hundredths of an hour. HECON, GO series or approved equal.
- F. Control Relays

1. Relays for general purpose use shall be DPDT or 3PDT, 10 amp contacts with the appropriate coil voltage for the application. They shall have an 8-pin base, matching socket, and contact status indicator. Units shall be Allen-Bradley Bulletin 700 type HA, HB or approved equal.

G. Time Delay Relays

1. Time delay relays shall be multi-function, multi-range with plug-in base, pin style terminations timing and timed out LED indicators, and calibrated scales. Relays shall have minimum .5 seconds to 60 minutes, 8 selectable timing ranges, 5 amp contacts. Select coil voltage for the application. Minimum accuracy requirements (plus or minus) shall be as follows: 1) Repeat accuracy 1/2% 2) Timing change over full voltage range 1/2% change over full temperature range 2% 3) Scale tolerance 5%. Allen-Bradley Bulletin 700 type HR series or approved equal. Appropriate relay shall be selected based on application from the control wiring diagrams

H. Terminal Blocks

1. Terminal boards shall be 300 or 600 volt modular terminal blocks with tubular screw and pressure plate. Terminal shall be sized to accept 2-#14 wire minimum. Provide a minimum of 20% or four (whichever is more) spare terminals in each bucket. Allen-Bradley Bulletin 1492-CA1 or approved equal.

2.04 NAMEPLATES:

- A. Each motor control center compartment shall have a nameplate designating the equipment and its identifying number and size or rating. Data shall be as shown on one-line diagrams. Nameplates shall be made of 1/16" thick machine engraved laminated phenolic having black letters not less than 3/16" high on a white background. Nameplates shall have name, number and/or function as is applicable for clear identification.
- B. Provide one large nameplate for each motor control center identifying the motor control center name and number with 1" lettering.
- C. Equipment titles and numbers shall be completely spelled out on nameplates or as shown on the drawings. Nameplates on steel panels shall be secured with stainless steel drive screws. Where it is proposed that nameplates will be secured with pressure sensitive tape or bonding cement, the process and samples shall be submitted to the Engineer for acceptance.
- D. Nameplates shall also be provided for identifying all operator interface (lights, switches, etc.) and other devices that are located outside or inside the panels.
- E. Nameplates shall also be provided for identifying all relays and devices that are located inside the panels and shall be of the sandwich phenolic described above or equal.
- F. Nameplates shall be mounted in a manner or location such that other equipment or devices do not block them so they are easily viewed.
- G. Nameplates for motor data provided under section 26 70 00 shall be mounted inside the door in the appropriate MCC bucket.

2.05 FUSES:

- A. Provide fuses, spares, fuse pullers, and etc. in accordance to Section 26 28 00
- B. Provide blown fuse indicators on all fuses.

2.06 OPERATING MECHANISMS:

- A. All circuit breakers in motor control centers shall be provided with external "thru-the-door" operating handles. Square D Class 9422 , Allen-Bradley Bulletin 1494, or approved equal.

2.07 SPARE PARTS:

- A. In addition to spare parts mentioned elsewhere in this section, the Contractor shall supply the following spare parts for use by the Owner:
 - 1. 100% spare bulbs of each type used for indicating lights.
 - 2. one spare control, time delay phase fail, etc. relay of each type used. or 20% whichever is the greater number.
 - 3. one spare lens of each color used for indicating lights.
 - 4. Two spare fuses for each fuse provided under 10 amps and one spare fuse for each fuse provided over 10 amps.
- B. Spare parts shall be provided with the motor control equipment when shipped to the site.

3.00 EXECUTION

3.01 GENERAL:

- A. It is the Contractors responsibility to verify that the motor starters, protection equipment, and other components, etc. provided are suitable (correct phase, voltage, starter type, correct breakers, and overload relays) for the motors and equipment loads being served.
- B. Operator interface devices such as metering and devices with control and displays shall be installed between 5' and 5'-8" above finished floor. Operator interface devices on full height sections shall be installed between 4'-6" and 6' above finished floor.
- C. Motor control center shall be installed to meet seismic zone 3 requirements according to the manufacturer's recommendations.
- D. Provide wire and terminal numbering on all wires and terminals.
- E. Provide schematic and layout drawings for each individual unit.

3.02 TESTING:

- A. Testing and inspection of the motor control center shall include all components. All motor controllers shall be interconnected with the control system and powered with rated incoming voltage.

3.03 INSTALLATION:

- A. The motor control center shall be installed in accordance with the installation drawings and instructions. Installation shall be performed by workers who are skilled and experienced in the installation of motor control equipment. It is the contractor's responsibility to provide sufficient

space for the equipment and size of equipment to fit within the space requirements and meet all code requirements.

- B. Installation shall include all elements and components of motor control equipment and all conduit and interconnecting wiring between all elements, components, and sensors. All wiring between cabinets, sensors, pumps and equipment shall be multiple color coded with at least twenty individual colors for ease of servicing. All terminations shall be made with solderless pressure connectors. All wiring shall be in accordance with the requirements of Section 26 05 19. Intrinsically safe wiring shall be separated with barriers per NEC requirements.

3.04 WIRING:

- A. Refer to Section 26 05 19 - Wire and Cable Termination.
- B. Separately bundle all signal, low voltage, and control wiring from 120V and 480V power wiring and maintain a minimum of 1-inch separation of conductors of different voltage.

3.05 IDENTIFICATION:

- A. Refer to Section 26 60 02 for applicable painting, nameplates, and labeling requirements.

****END OF SECTION****

1.00 GENERAL

1.01 DESCRIPTION OF WORK INCLUDED:

- A. The work described in this Section includes excavation, backfill, and compaction for structures, appurtenances, and roadways and the furnishing, transportation, placement, compaction and finish grading of embankment materials as shown on the Plans and specified herein, including, but not limited to:
1. Construction and completion of cuts, fills, dikes, slopes, ditches, roadways, and related work.
 2. Structural excavation and structural backfill using imported select or native material.
 3. Disposal of excess excavated material.
 4. All other work required to complete the earthwork as specified herein and shown on the Drawings.
- B. Unless specified elsewhere, the work of this Section also includes clearing, grubbing, removal of all materials of whatever nature in excavation and fill limits, disposal of all waste materials, subgrade preparation, finish grading, repairs and restorations of existing improvements, maintenance of temporary surfaces as required, and clean-up.
- C. Trench excavation, backfill and compaction, if applicable, shall be as specified in Section 31 23 00.
- D. See also Section 32 10 00 - Surface Improvements and Restoration for A.C. pavement, concrete, and other surface removal and placement items.
- E. Special provisions, requirements, and/or revisions to this Specification and/or Bid Item(s) may be included in Section 01 01 00 (green pages) and/or on the Drawings or Details.

1.02 QUALITY ASSURANCE:

A. Soils and Backfill

Moisture density standard ASTM D1557 method unless otherwise specified.

B. In-Place Density Determination

Sandcone method ASTM D1556 or Nuclear Method ASTM D6938.

C. Classification of Soils

Soil classification shall be ASTM D2487.

1.03 SUBMITTALS:

- A. Submittals shall conform to Section 01 33 00 of the Specifications.

- B. All materials shall be reviewed by the Engineer prior to the start of work. The Contractor shall notify the Engineer in advance of his intention to import material and of the borrow area selected. If feasible, the Engineer will inspect the material and source for approval, or he shall require the Contractor to submit representative samples of proposed materials for review. If the Contractor chooses to manufacture and/or process in any way materials to be used, whether the material is to be imported, borrowed on-site, or obtained directly from the excavation, such material and process shall be approved by the Engineer prior to its use. All materials, whether native or imported, shall be subject to continued review by the Engineer for approval or rejection as the work progresses.
- C. Unless specified otherwise elsewhere, prior to beginning of any excavation work, the Contractor shall provide the Engineer with an opportunity to obtain representative samples of all backfill materials, including representative native materials, to be used for determination of Proctor moisture-density curves. Unless specified otherwise, the cost of such determinations shall be the responsibility of the Owner. It is the Contractor's responsibility to provide such samples, or the opportunity for the Engineer to obtain such samples adequately, in advance of the work.

1.04 **GENERAL CONSTRUCTION REQUIREMENTS:**

A. **Streets**

It is the Contractor's responsibility to keep the streets free of dirt and debris resulting from his work. The Contractor shall provide wheel cleaning stations to clean wheels and undercarriage of vehicles before leaving site, or provide street cleaning as necessary, to prevent dirt and debris from being carried onto public streets.

2.00 **PRODUCTS**

2.01 **GRANULAR CUSHION/GRANULAR FILL:**

Granular cushion material under all footings and slabs shall consist of crushed, processed or naturally occurring granular material free from organic matter and conforming to the following gradation when tested in accordance with ASTM D422. Granular Fill material for footings and slabs shall conform to all requirements of Granular Cushion.

<u>U.S. Standard Sieve</u>	<u>Percent Passing, by Wt.</u>
1-½	100
No. 4	30-60
No 40	10-25
No 100	0-12
No. 200	0-5

2.02 **STRUCTURAL BACKFILL:**

A. **Granular Structural Backfill**

Structural backfill shall be placed as shown on the Drawings, and shall consist of free draining screened or naturally occurring granular material meeting the following gradation requirements:

<u>Size Opening</u>	<u>% Passing</u>
2-½" square sieve	100
2" square sieve	65-100
1" square sieve	50-100
¼" square sieve	0-75
U.S. #40	25 Max.
U.S. #200 sieve	0-5

B. Common Structural Backfill

Unless other or additional backfill material requirements are indicated in Section 01 01 00 and/or on the Drawings or Details, common structural backfill material shall be well-graded sand, gravel, crushed rock, or native soil material free of humus, organic, frozen or deleterious material and debris. It shall contain no rocks larger than 6" in largest dimension, with no more than 25% of the material being such rock. The material shall contain no more than 5% by weight passing the No. 200 Sieve. It shall also be free of any consolidated, saturated, or deleterious matter that may damage structures or present a compaction problem. If the Engineer determines that the native excavated material is unsuitable for backfill, the Contractor shall backfill with approved native material from another work area or, if not available, with imported material.

2.03 EMBANKMENT:

A. General

Embankment material shall be constructed of on-site excess excavated native soil, or approved similar imported fill material.

B. Embankment

The earth embankment material shall be free of leaves, roots, sod, grass, pieces of wood, bark, organic material, top soil, and frozen soil that could be detrimental to the integrity of the finished embankment. Prior to placement, materials must be approved by the Engineer.

2.04 DRAIN ROCK:

Drain rock shall be free draining, rounded, washed, gravel with a maximum size of ¾" and a minimum size at least 25% larger than the perforations in the drain pipe.

2.05 FOUNDATION STABILIZATION MATERIAL:

Foundation stabilization material, where required to replace soft or unsuitable excavation bottoms, shall be well-graded 2-½" minus granular material essentially free of dirt, silt, clay, and organic or deleterious matter. The material shall have no more than 5% by weight passing the No. 200 sieve size.

2.06 RIPRAP:

A. Riprap shall consist of hard, angular, broken stone of such quality that they will not disintegrate upon exposure to water or weathering. Stone shall be free from segregation, seams or cracks.

- B. Riprap shall be free of rock fines, soil, silt, clay, organic or other extraneous materials.
- C. Size of riprap shall be as shown on the Drawings or as specified herein.

2.07 CRUSHED ROCK FOR BASE OR TOP COURSE:

- A. Crushed rock shall conform to WSDOT 9-03.9(3) for Crushed Surfacing Base Course or Top Course as called out on the Drawings.
- B. Test results, or other evidence satisfactory to the Engineer, shall be provided by the Contractor to show that the proposed material meets the requirements herein, prior to material delivery to the project. Provide a physical sample as requested by the Engineer.

2.08 CRUSHED ROCK FOR GRAVEL SURFACING:

Gravel surfacing shall be as specified herein for Crushed Rock.

2.09 OTHER FILL MATERIAL:

Unless other or additional fill material requirements are indicated on the Drawings, fill material shall be sand, gravel, crushed rock, or native excavated material, free of humus organic, frozen or deleterious material and debris.

2.10 GEOTEXTILE FABRIC:

Geotextile or filter fabric, as required, shall be as specified on the Drawings or Details, in Section 01 01 00, Section 31 05 19.13, or elsewhere in the Contract Documents.

3.00 EXECUTION

3.01 SITE PREPARATION:

A. Clearing/Grubbing/Stripping

1. Where clearing or partial clearing of work area is required, such clearing shall be completed prior to starting excavation or fill. Unless other or additional clearing, grubbing, and/or existing surfaces removal requirements are specified elsewhere in the Specifications or on the Drawings, pavements, trees, brush, grass, roots and other materials in the work area that are unsuitable for fill shall be stripped and disposed of off-site, in conformance with all applicable ordinances and regulations. In no case shall excavation, fill, or embankment material cover brush or trees.
2. The Contractor shall provide the Owner and Engineer with an erosion and sedimentation control plan for review and acceptance. Prior to beginning work, the Contractor shall install the erosion control facilities.

B. Subgrade Preparation

1. After clearing, grubbing, and stripping as required, the areas to receive fill or embankment materials shall be uniformly graded to promote proper drainage through the site. All excavations and depressions shall be filled with compacted, approved native or imported granular fill materials as specified for Foundation Stabilization Material.
2. All surfaces shall be proof rolled. Notify the Engineer in advance when subgrade will be ready for proof-rolling or compaction. Soft areas shall be excavated and re-compacted to the original subgrade level with the granular fill material as specified for Foundation Stabilization Material. A geotextile fabric, used in conjunction with the granular fill, can be used to limit excessive excavation depths in areas of soft subgrade as approved by the Engineer for design conditions.
3. Granular fill should be placed in uniform loose layers not exceeding 10" in thickness, prior to compaction, and should be compacted to a minimum of 95% of the maximum dry density and within 2% of optimum moisture content, as determined according to ASTM D 1557. In areas where small hand compaction equipment is required, the backfill should be placed in lifts not exceeding 4" prior to compaction.
4. Subgrade shall be prepared, compacted, or proof-rolled when unfrozen and free of ice, snow, standing water, debris and/or foreign material. Do not use portions of prepared subgrade surface as haul roads, and protect from traffic. The surface shall not have holes or depressions more than 1", or protrusions extending above the surface more than 1" where a geotextile fabric is not used. Where a geotextile fabric is used, remove all protrusions which could damage the fabric. Remove any material having a diameter greater than 3", including rocks, asphalt, or concrete from upper 6" of subgrade preparation zone.

3.02 OBSTRUCTIONS:

- A. Objects that are encountered during excavation operations, such as tree roots, stumps, broken concrete, abandoned piping, logs, debris, paving, railroad ties, or any and all other obstructions shall be removed and disposed of off-site in conformance with all applicable ordinances and regulations.
- B. Unless a separate payment item or items are provided in the Contract Documents, the cost of removal and disposal of such obstructions, as well as the cost of delays that may be caused by same, shall be considered incidental to earthwork excavation and no additional payment will be made.

3.03 CLASSIFICATION OF EXCAVATION:

A. General

1. Excavation may be classified or unclassified. If no other excavation classifications or Bid Items are provided, then all excavation of any nature, including excavation and disposal of rock as defined herein, shall be considered incidental to the excavation and no additional payment will be made.
2. Excavation shall include any and all material of whatever nature that must be transported to another site for disposal or for temporary stockpiling, prior to backfill, due to confined work area, or transported to another backfill location for any reason. Unless specifically provided for in Bid

Items, all costs of such handling, transport, stockpiling and/or disposal shall be considered incidental to excavation and no additional payment will be made therefore.

3. All excavations shall be sloped and/or braced and sheeted in accordance with the most stringent of the applicable laws and regulations, in accordance with good safety practice, and as necessary to protect persons, adjacent or affected property, and the work. The Contractor shall be solely responsible for determining and utilizing the necessary sloping, bracing and/or sheeting.

B. Excavation

Excavation for site work, structures, and roadways includes that which is necessary for the construction of foundations, slabs, and roadway bases, including excavation for placement of granular cushion and foundation and/or site drain systems.

C. Rock Excavation

1. Rock excavation shall be excavation of boulders (exceeding 1.0 cubic yard in volume), ledge rock, or other solid rock material requiring pneumatic equipment ("hoe ramming") or systematic drilling and blasting for its removal. Boulders, or other rock larger than 1.0 c.y. not requiring the use of pneumatic equipment ("hoe-ramming") or drilling and blasting, shall not be considered rock excavation under this bid item. Hard pan, hard clay and glacial till or sandstone, siltstone, shale or other rock which is soft or weathered, or other extensively fissured rock will not be considered rock excavation and is not defined as rock requiring drilling and blasting or hoe ramming. No drilling and blasting or hoe ramming of rock shall be done without prior approval by the Engineer that such operations are required.
2. All boulders, ledge rock, and other solid rock shall be removed to provide at least 6" clearance below any pipe to be installed. Excess excavated rock material and rock excavation that is not suitable for backfill shall be removed and disposed of off-site by the Contractor. Unless a specific bid item is provided, such removal and disposal of excess or unsuitable rock excavation material shall be considered incidental and no additional payment shall be made. Materials removed shall be replaced with materials from adjacent excavations or with imported material, as designated by the Engineer.
3. If rock excavation is to be accomplished through drilling and blasting, the blasting shall be done in such a manner to prevent damage to structures, utilities and other improvements, but in no case shall ground vibration exceed 2 inches/second peak particle velocity for 40 hertz and greater frequency of vibration. The Contractor shall submit a blasting program seven (7) days prior to any drilling. Drilling and blasting shall not commence until the Engineer has reviewed the submitted blasting program. Review of the blast plan by the Engineer shall in no way relieve the Contractor of the sole responsibility for the accuracy, adequacy or safety of the plan when implemented in the field, nor for any damage to structures, utilities or improvements that may result. The Contractor shall be solely responsible for the planning and execution of any and all drilling and blasting and for its adequacy, safety, and compliance with all applicable laws, ordinances and regulations. All drilling and blasting shall be done in strict conformance to federal, state and local requirements pertaining to this work, and with materials and methods that assure the protection of persons and property. Any damage or injury to persons or property, including existing buried utilities or structures, resulting from rock excavation operations, shall be the sole responsibility of the Contractor.

4. Whenever blasting is required, the Contractor shall conduct a pre-blast structure survey on all structures above and below ground within the affected area of work that may be subject to blasting damage. The survey shall be conducted prior to the start of any blasting operation and shall include an area of at least 250 feet ahead, behind, and to the sides of any area to be blasted. The Contractor shall complete the pre-blast survey of all structures that could be affected by a particular blast a minimum of two (2) days prior to said discharge, and deliver a copy of the survey to the Engineer not later than one (1) day prior to the blasting operation. The Contractor also shall make every effort to keep the owners of structures that could be affected by a blast informed as to the timing of the discharges. However, it is the Contractor's responsibility to conduct the survey in a manner to ensure all structures having reasonable possibility of sustaining blast damage are included in the survey, irrespective of their proximity to blast site. The pre-blast structure survey shall be recorded on appropriate forms and may be supplemented by photographs, video tapes, tape recordings, or other suitable methods of documentation. One copy of the form shall also be delivered to the Engineer no later than one (1) week after the survey is completed, unless required sooner as provided for herein.
5. All blasts shall be recorded with one or more seismographs capable of recording the three components of motion. The Engineer shall be notified a minimum of two (2) hours prior to blast detonation. Seismographs shall be located proximate to the excavation site and adjacent to the closest sides of the closest structures (or wells) to the blast. The Contractor shall record the location, time and ground vibration for each blast on a suitable documentation form and deliver a copy of the form to the Engineer no later than one (1) week after the blast is detonated.

3.04 EXCAVATION SAFETY SYSTEM:

- A. The Contractor shall provide an Excavation Safety System in compliance with all federal and state regulations. The safety system shall meet the provisions of the Washington Industrial Safety and Health Act, as set forth in the latest Revised Code of Washington (RCW), as required for excavations.
- B. Neither the Engineer nor the Owner will inspect, review, approve, or have any liability for the adequacy of the Contractor's Excavation Safety System.

3.05 EXCAVATION LINE AND GRADE:

- A. Site excavations shall be made to lines and grades indicated by the Drawings and Specifications and/or as established by the Engineer in the field, with proper allowance for all granular cushion, foundation and/or site drain, roadway bases and foundation replacement requirements. Unless shown otherwise in Section 01 01 00, or on the Drawings or Details, excavations shall allow for the installation of at least 4" of granular cushion beneath footing and slab areas.
- B. If excavations are carried below the required grade at the option of, or error by, the Contractor, the excavation bottom shall be brought back to grade with compacted bedding or foundation replacement material compacted in lifts to 95% density as herein specified, at no additional cost to the Owner.
- C. Excavation planning and operations shall result in the installation of all embankments, structures, cushions, bases, foundations and drain systems in full conformance with the installation and testing requirements specified for the particular structure and/or appurtenances for which the excavation is intended. In all cases, regardless of the relative compaction achieved, a firm and unyielding excavation bottom shall be provided for embankments, roadways, structures and appurtenance foundation.

3.06 UNSUITABLE FOUNDATION CONDITIONS:

Wherever excavations for structures result in a bottom that contains voids, is saturated, soft, or in any other way in the opinion of the Engineer is unsuitable for foundation, such material shall be removed to a depth approved by the Engineer and disposed of by the Contractor. Approved Foundation Stabilization Material shall be placed and compacted by the Contractor in lifts, to a relative density of at least 95% as herein specified.

3.07 CONTROL OF WATER:

- A. During excavation, installation of structures and appurtenances, backfill operations, and the placing and curing of concrete, all excavation areas shall be kept free of water except as otherwise specified or designated on the Drawings. The Contractor shall, at all times, control surface and subsurface drainage so as to prevent its entering the work.
- B. The Contractor shall furnish, install and operate in such locations and, when necessary, provide such equipment and materials required to keep excavations free from water and shall dispose of water without causing nuisance, damage, or injury to persons or property. He shall have on hand, at all times, sufficient and reliable pumping equipment and pump drives in good working order and operational, in spite of all ordinary emergencies, including power outages. He shall also have available, at all times, adequate and competent manpower to operate and maintain such equipment as necessary.
- C. The control of groundwater shall also prevent the softening of excavation bottoms and dewatering materials, equipment, and methods shall prevent the removal of natural soils. Dewatering operations shall draw down subsurface water to a level at least 1 foot below the bottom of the excavation, result in the maintenance of the undisturbed state of foundation soils, and allow proper pipe, structure, and appurtenance installation, as well as the installation and compaction of all backfill materials to the specified density. Dewatering installation and operations shall not reduce the water level to the extent that it may damage or endanger other structures or improvements in the vicinity.
- D. Open and cased sumps shall not be used as primary dewatering methods for excavations deeper than 3 feet below the static water level.
- E. The release of groundwater to its static level shall be performed in such a manner as to maintain the undisturbed state of the foundation soils, prevent disturbance of compacted backfill materials, and prevent flotation or movement of structures or appurtenances.
- F. Unless a separate Bid Item is provided, all control of water and dewatering design, labor, materials and equipment shall be considered incidental to earthwork and no additional payment will be made therefore.

3.08 MATERIAL INSTALLATION AND COMPACTION:

A. Granular Cushion

- 1. After excavation and before placement of granular cushion, the exposed surface shall be brought to optimum moisture content and compacted to 95% of maximum density (ASTM D-1557) for a minimum depth of 1 foot.

2. Granular cushion shall be placed in lifts and compacted to 95% of maximum density (ASTM D-1557) by means of vibratory compactor or other means suitable for the conditions.

B. Structural Backfill and Compaction

No backfill material shall be placed until the structure has been approved and the concrete has set and cured to the specified required minimum 28-day compressive strength, as indicated by laboratory testing, as specified elsewhere. All granular structural backfill and common structural backfill shall be placed in lifts not exceeding 8" as measured before compaction, and compacted to 90% maximum density as specified by ASTM-D1557. Backfill within 5 feet of structural walls shall be placed in lifts not exceeding 4" and compacted to 90% maximum density, as specified, using hand-operated compaction equipment only.

C. Embankment

1. No embankment material shall be placed until the subgrade has been prepared as specified for Subgrade Preparation. Whenever the subgrade is of such nature that, in the opinion of the Engineer, it would impair the stability of the embankment, the unsuitable material shall be removed to the required width and depth and shall be disposed of as directed. Stump holes or other small excavations within the limits of the embankment shall be filled and compacted as specified for Subgrade Preparation before commencing embankment construction.
2. Snow shall be removed from the subgrade prior to construction of the embankment. No embankments shall be constructed on frozen subgrade unless permitted in writing.
3. Earth embankments shall be constructed to the lines and grades shown on the Drawings to a tolerance of 0.1 foot of finished grade. The distribution of the materials through the earth fill shall be such that the fill will be free from lenses, pockets, streaks, or layers of material differing materially in structure or gradation from the surrounding material. The combined excavation and placing operations shall be such that the materials, when compacted in the earth fill, will be blended sufficiently to secure the best practicable distribution of the material and, for this purpose, the Engineer may designate the locations in the earth fill where the individual loads shall be deposited. Embankments shall be built up by means of mechanical excavating and hauling equipment and compacted in horizontal layers, not to exceed 12" in thickness before compaction. Regardless of the method used in constructing the embankment, the fill shall be carried approximately level across the entire width of the embankment, and the fill shall be brought out to the required slope. The use of loose material to widen fills will not be permitted. Areas found to be of inadequate width at any time shall be removed and reconstructed to the proper width. If the surface of any layer of earth fill is too dry or smooth to bond properly with the layer of material to be placed thereon, it shall be moistened and/or scarified by harrowing before the next succeeding layer of earth fill is placed.
4. Fill material in embankment shall be placed so that each layer shall be kept as level as practicable, and travel over the embankment shall be directed so as to distribute the compacting effort to the best advantage. The fill portions of the embankment shall be compacted to 90%, unless shown otherwise in the Drawings or Section 01 01 00. Prior to and during the compacting operations, the material in each layer shall be the optimum practicable moisture content required for compaction purposes.

5. Embankment material containing excessive moisture shall be permitted to dry to a moisture content that will permit the required compaction. No extra payment will be made for rehandling such material to permit drying. Embankment material that does not contain sufficient moisture to compact to the required density shall be uniformly moistened as required. Adequate sprinkling devices of an approved type shall be provided and used by the Contractor.

D. Roadway Bases

1. No roadway base material shall be placed until the subgrade has been prepared as specified for Subgrade Preparation. Whenever the subgrade is of such nature that, in the opinion of the Engineer, it would impair the stability of the roadway, the unsuitable material shall be removed to the required width and depth and shall be disposed of as directed. Stump holes or other small excavations within the limits of the roadway shall be backfilled and compacted, as specified for Subgrade Preparation, before commencing roadway construction.
2. Snow shall be removed from the subgrade prior to construction of the roadway. No roadway bases shall be constructed on frozen subgrade, unless permitted in writing.
3. Roadway bases shall be constructed to the lines and grades shown on the Drawings. Roadway bases shall be built up by means of mechanical equipment and compacted in layers, not to exceed 6" in thickness before compaction. Regardless of the method used in constructing the roadway, the fill shall be carried approximately level across the entire width of the roadway. The use of loose material to widen fills already compacted will not be permitted. Areas found to be of inadequate width at any time shall be removed and reconstructed to the proper width.
4. Roadway bases shall be compacted to 95%, unless shown otherwise in the Plans or Section 01 01 00. Prior to and during the compacting operations, the material in each layer, including the base material on which a new layer is being placed, shall be the optimum practicable moisture content required for compaction purposes. Typically, this shall be within $\pm 2\%$ of optimum moisture content.
5. Roadway base material containing excessive moisture shall be permitted to dry to a moisture content that will permit the required compaction. No extra payment will be made for rehandling such material to permit drying. Roadway base material which does not contain sufficient moisture to compact to the required density shall be uniformly moistened as required. Adequate sprinkling devices of an approved type shall be provided and used by the Contractor.

3.09 FILL SETTLEMENT:

Settling of any embankment, fill, or backfill within one (1) year after final acceptance of the work shall be considered incontrovertible evidence of inadequate compaction. Upon notification of such settlement, the Contractor shall promptly perform such remedial work as may be required to correct the deficiency to the satisfaction of the Owner, including replacement of surfacing materials, at no additional cost to the Owner. If such remedial work is not promptly performed, the Owner may exercise its rights as holder of the required performance bond and make such repairs as it deems fit, recovering the resulting expenses from the bond surety.

3.10 FINISH GRADING:

Finish grading shall be as specified in Section 02245.

3.11 RESTORATION, FINISHING AND CLEAN-UP:

The Contractor shall restore, replace or repair such surfaces, structures, and improvements as may have been disturbed, removed, or damaged as a result of his operations. All such items shall be returned to a condition equal to that before the work began and to the satisfaction of the Owner. All surplus and waste materials shall be removed and surfaces cleaned. All existing drainage facilities and ditches shall be carefully and completely restored to their intended function as soon as possible after disturbance, even if all other work in the area is still in progress. Partial or final payments may be withheld if required restorations, repairs, finishing and cleanup are not satisfactorily completed.

3.12 WASTE MATERIAL DISPOSAL:

All waste material, including excess excavated or embankment material, shall be disposed of off-site by the Contractor, unless specified otherwise in Section 01 01 00 or on the Drawings or Details. Removal and disposal shall be in accordance with all applicable federal, state and local regulations, and applicable portions of these Contract Documents. Unless specified otherwise in Section 01 01 00 or on the Drawings, the Contractor shall be solely responsible for procuring an appropriate disposal site. Unless a separate Bid Item is provided, all costs associated with the removal and disposal of waste material, including excess excavated or embankment material, shall be considered incidental to other payment items and no additional payment shall be made.

4.00 MEASUREMENT AND PAYMENT

4.01 GENERAL:

See Section 01 22 00 - Measurement and Payment, for General Requirements. See Section 01 01 00 - Special Requirements/Bid Items for possible modifications to Standard Bid Items. If no specific bid item is provided, measurement and payment shall be considered incidental and shall be included in the bid price for other items of work for the project.

4.02 BID ITEMS:

A. Special provisions, requirements, revisions to these Bid Items, and/or additional Bid Items, may be included in Section 01 01 00 (green pages) or on the Drawings or Details.

B. Excavation, Embankment, Backfill and Compaction

1. Includes all grading, excavation, fill and/or backfill and compaction of native material required for the construction and completion of all dikes, cuts, fills, embankments, slopes, ditches and graded areas. Also included shall be transporting, stockpiling, disposal of excess material, and any related work, unless a separate bid item is provided for same. Excess material removed as a result of utilizing imported material is included unless a separate bid item is provided (see Bid Items below). Excavation and backfill for structures are included in this bid item, unless a Structural Excavation and Backfill bid item is provided or unless it is included in a special bid item in Section 01 01 00.

2. Payment shall be made on a unit price, cubic yard (C.Y.) or lump sum (L.S.) basis as indicated on the bid form.

C. Imported Embankment and Backfill

1. Includes furnishing, placing and compacting the specified imported material for embankments and/or backfilling in conformance with applicable material specifications, Drawings or Details, or where directed or approved by the Engineer. Transporting imported material to the site and transporting and disposing of excess material resulting from the utilization of imported material is also included.
2. Payment shall be made on a unit price, cubic yard (C.Y.), or lump sum (L.S.) basis as indicated on the bid form.

D. Imported Granular Cushion

1. Includes furnishing, transporting, placing, and compacting the specified imported granular cushion material in conformance with these specifications. It also includes transporting and disposing of excess material resulting from the utilization of imported granular cushion.
2. Payment shall be made on a unit price, cubic yard (C.Y.), or lump sum (L.S.) basis as indicated on the bid form.

E. Foundation Stabilization

1. Includes excavation, transporting and disposing of unsuitable material, furnishing, transporting, placing and compacting the specified foundation stabilization material in conformance with these specifications.
2. Payment shall be made on a unit price, cubic yard (C.Y.), or lump sum (L.S.) basis as indicated on the bid form.

F. Rock Excavation

1. Includes all work necessary to hoe ram or systematically drill and blast boulders (larger than 1.0 cubic yard), ledge rock or other solid rock formations. Also included is disposal of shot rock.
2. Measurement and payment shall be as indicated on the Bid Form and shall be on a lump sum (L.S.) basis or unit price per cubic yard (C.Y.) of hoe rammed or drilled and shot rock as measured in place by the Engineer prior to blasting or hoe ramming. Measurement and payment limits shall not extend beyond the actual vertical dimensions of rock within the trench or structural excavations, or beyond the finished sub-grade elevations of other excavations.

G. Gravel Surfacing

1. Includes furnishing, placing, compacting and grading of the specified gravel surfacing.

2. Payment shall be on a unit price, cubic yard (C.Y.), square yard (S.Y.), or lump sum (L.S.) basis as indicated on the bid form.

H. Riprap

1. Includes furnishing and placing of the specified riprap materials. Different size riprap will be listed under separate Bid Items.
2. Payment shall be on a unit price, cubic yard (C.Y.), square yard (S.Y.), or lump sum (L.S.) basis as indicated on the bid form.

I. Excavation Safety System

This bid item shall include furnishing and implementing an excavation safety system in conformance with the applicable codes and specifications. Payment shall be on a lump sum (L.S.) basis.

****END OF SECTION****

1.00 GENERAL

1.01 DESCRIPTION:

- A. The Contractor shall furnish all labor, materials, and equipment necessary to finish grade all areas disturbed in the construction of this project.
- B. Special provisions, requirements and/or revisions to this Specification and/or Bid Item(s) may be included in Section 01 01 00 (green pages) and/or on the Drawings or Details.

2.00 PRODUCTS

During finish grading operations the Contractor shall utilize native and excess excavated materials, substantially free from rock (in excess of three (3) inches in diameter), wood, bark, grass, or other organic matter.

3.00 EXECUTION

- A. Finish grading shall be carried out to the elevations and grades as shown on the plans. If such information is not provided on the plans, the Contractor shall grade the project areas to provide drainage and to uniformly blend with the contours and grades existing prior to construction. Unless additional or other requirements are indicated elsewhere in the specifications or on the plans, all surfaces, except paved surfaces, shall be graded to within 0.1 ft. of the elevations shown on the plans.
- B. Finish grading shall include the removal from the project sites of all exposed rocks greater than 3 inches in diameter and disposing of them in an area procured by the Contractor.

4.00 MEASUREMENT AND PAYMENT

Payment for Section 31 22 19 shall be considered incidental and shall be included in the prices bid for other items provided in the Bid.

****END OF SECTION****

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1.00 GENERAL

1.01 DESCRIPTION:

- A. The work specified in this Section includes trench excavation for pipe and appurtenances, bedding, trench backfill, compaction, finish grading and clean-up. Unless specified elsewhere, the work of this Section also includes clearing, grubbing, removal of all materials of whatever nature in the excavation limits, disposal of all waste materials, repairs and restorations, and maintenance of temporary surfaces as required.
- B. Special provisions, requirements and/or revisions to this Specification and/or Bid Item(s) may be included in Section 01 01 00 (green pages) and/or on the Drawings or Details.
- C. See also Section 32 10 00, Surface Improvements and Restoration for A.C. pavement, concrete, and other surface removal and placement items.

1.02 QUALITY ASSURANCE:

A. Soils and Backfill

Moisture density standard ASTM D1557 method unless otherwise specifically approved.

B. In-Place Density Determination

Sandcone method ASTM D1556 or nuclear method ASTM D6938.

C. Classification of Soils

ASTM D2487

1.03 SUBMITTALS:

- A. Submittals shall conform to Section 01 33 00 of the Specifications.
- B. All materials shall be approved by the Engineer prior to the start of work. The Contractor shall notify the Engineer in advance of his intention to import material and of the borrow area selected. If feasible, the Engineer will inspect the material and source for approval, or he shall require the Contractor to submit a representative sample of proposed material for review. If the Contractor chooses to manufacture and/or process, in any way, materials to be used, whether the material is to be imported, borrowed on-site, or obtained directly from the excavation, such material and process shall be approved by the Engineer prior to its use. All materials, whether native or imported, shall be subject to continued review by the Engineer for approval or rejection as the work progresses.
- C. Unless specified otherwise elsewhere, prior to beginning of any excavation work, the Contractor shall provide the Engineer with an opportunity to obtain representative samples of all backfill materials, including representative native materials, to be used for determination of Proctor moisture-density curves. Unless specified otherwise, the cost of such determinations shall be the responsibility of the Owner. It is the Contractor's responsibility to provide such samples, or the opportunity for the Engineer to obtain such samples adequately, in advance of the work.

2.00 PRODUCTS

2.01 FOUNDATION STABILIZATION MATERIAL:

Unless other or additional requirements are specified in Section 01 01 00 and/or on the Drawings or Details, foundation stabilization material, where required to replace soft or unsuitable trench bottoms, shall be well-graded, 2-1/2 inch minus granular material essentially free of dirt, silt, clay, and organic or deleterious matter. The material shall have no more than 10% by weight passing the No. 200 sieve size.

2.02 PIPE BEDDING MATERIAL:

A. Ductile Iron & Steel Pipe (All Sizes), Thermoplastic Pipe 4" Diameter and Larger

Unless other or additional bedding material requirements are required by the Drawings, pipe bedding material to be installed and compacted under, around and above all pipe as specified in this Section shall be clean, well-graded sand or sand/gravel mixture with a maximum particle size of 3/4 inch, entirely free of clay, silt, organic or deleterious matter and frozen material. Minimum material weight shall be 110 pounds per cubic foot at 95% relative compaction. Bedding shall conform to the following gradation requirements:

<u>Sieve Size</u>	<u>Percent Passing</u>
1" square	100
1/4" square	25-80
U.S. No. 200	0-7

B. Copper Water Service Pipe, Thermoplastic Pipe Less Than 4" Diameter

All requirements of 2.02 A. herein apply, except that bedding material shall be clean sand, free of gravel, with no more than 5% passing the No. 200 Sieve (by weight).

2.03 TRENCH BACKFILL MATERIAL:

Unless other or additional trench backfill material requirements are indicated on the Drawings, trench backfill material shall be well graded, sand, gravel, crushed rock, or native soil material free of humus, organic, frozen or deleterious material and debris. It shall contain no rocks larger than 12" in largest dimension, with no more than 25% of the material being such rock. The material shall contain no more than 5 percent by weight passing the No. 200 sieve. It shall also be free of any consolidated, saturated or deleterious matter that may damage the pipe or structures or present a compaction problem. There shall be no rocks larger than 4 inches in largest dimension within 2 ft. of the pipe. There shall be no material larger than 3 inches in largest dimension in the upper 7 inches of the trench surface or subgrade zone. If the Engineer determines that the native excavated material is unsuitable for trench backfill, the Contractor shall backfill with approved native material from another work area or, if not available, with imported material.

3.00 EXECUTION

3.01 PREPARATION OF EXCAVATION AREA:

- A. Where clearing or partial clearing of the pipeline alignment and/or work area is required, such clearing shall be completed prior to starting trench excavation. Unless other or additional clearing, grubbing, and/or existing surfaces removal requirements are specified elsewhere in the Specifications or on the Drawings, pavements, trees, roots, brush, grass and other materials in the pipeline alignment that are unsuitable for trench backfill shall be stripped and disposed of off site, in conformance with all applicable ordinances and regulations. In no case shall trench excavation material cover brush or trees.
- B. All bituminous and concrete pavements in the trench excavation area shall be neatly cut in an approved manner prior to trench excavation. Such pavements, including roads, walks, parking areas, curbs, and other paved surfaces, shall be cut on each side at least 12" wider than the width of the top of the trench. In no case shall existing pavements be removed in such a manner as to damage the remaining pavement or lift it off its base material. Pavement materials so cut and removed shall be disposed of off site, in conformance with all applicable ordinances and regulations. Additional or other pavement removal requirements may be indicated on the Drawings or elsewhere in the Specifications.
- C. Unless a separate payment item or items are provided in the Specifications or on the Drawings, all costs of such stripping and disposal of waste material shall be considered incidental to trench excavation and no additional payment will be made therefore.

3.02 OBSTRUCTIONS:

- A. Objects encountered during trench excavation operations, such as tree roots, stumps, abandoned structures or portions of structures, abandoned piping, logs, debris, paving, railroad ties, or any and all other obstructions shall be removed and disposed of off site, in conformance with all applicable ordinances and regulations. The Engineer, if requested, may make changes in the pipeline alignment to minimize interference caused by such obstructions when encountered.
- B. Unless a separate payment item or items are provided in the Drawings or Specifications, the cost of removal and disposal of such obstructions, as well as the cost of delays that may be caused by same, shall be considered incidental to trench excavation and no additional payment will be made.

3.03 CLASSIFICATION OF TRENCH EXCAVATION:

A. General

1. Trench excavation may be classified or unclassified. If a trench rock excavation or drilling and blasting bid item is included, then the following definition of trench rock excavation shall apply to that bid item. If no trench rock excavation bid item is provided, and if no other excavation classifications and bid items are provided, then all trench excavation of any nature, including excavation and disposal of rock as defined below, shall be considered included in trench excavation and no additional payment will be made.
2. All trenches shall be sloped and/or braced and sheeted and trench excavation material stored and retained in accordance with the most stringent of the applicable laws and regulations, in accordance with good safety practice, and as necessary to protect persons, adjacent or affected

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property, and the work. The Contractor shall be solely responsible for determining and utilizing the necessary sloping, bracing and/or sheeting.

B. Trench Excavation

Trench excavation shall be such excavation where the excavated material is piled essentially beside the trench as it is removed and backfilled from this position. Also included in this definition is any and all material of whatever nature that must be transported to another site for disposal or for temporary stockpiling prior to backfill, hauled without stockpiling due to confined work area, or transported to another trench backfill location for any reason. Unless specifically provided for in other bid item(s), all costs of such handling, transport, stockpiling and/or disposal shall be considered incidental to trench excavation and no additional payment will be made.

C. Rock Excavation

1. Rock excavation shall be excavation of boulders (exceeding 1.0 cubic yard in volume), ledge rock, or other solid rock material requiring pneumatic equipment ("hoe ramming") or systematic drilling and blasting for its removal. Boulders, or other rock larger than 1.0 c.y. not requiring the use of pneumatic equipment ("hoe-ramming") or drilling and blasting, shall not be considered rock excavation under this bid item. Hard pan, hard clay and glacial till or sandstone, siltstone, shale or other rock which is soft or weathered, or other extensively fissured rock will not be considered rock excavation and is not defined as rock requiring drilling and blasting or hoe ramming. No drilling and blasting or hoe ramming of rock shall be done without prior approval by the Engineer that such operations are required.
2. All boulders, ledge rock, and other solid rock shall be removed to provide at least 6" clearance below the pipe. Excess excavated rock material and rock excavation that is not suitable for backfill shall be removed and disposed of off-site by the Contractor. Unless a specific bid item is provided, such removal and disposal of excess or unsuitable rock excavation material shall be considered incidental and no additional payment shall be made. Materials removed shall be replaced with materials from adjacent excavations or with imported material as designated by the Engineer.
3. If rock excavation is to be accomplished through drilling and blasting, the blasting shall be done in such a manner as to prevent damage to structures, utilities and other improvements, but in no case shall ground vibration exceed 2 inches/second peak particle velocity for 40 hertz and greater frequency of vibration. The Contractor shall submit a blasting program 7 days prior to any drilling. Drilling and blasting shall not commence until the Engineer has reviewed the submitted blasting program. Review of the blast plan by the Engineer shall in no way relieve the Contractor of the sole responsibility for the accuracy, adequacy, or safety of the plan when implemented in the field, nor for any damage to structures, utilities, or improvements that may result. The Contractor shall be solely responsible for the planning and execution of any and all drilling and blasting and for its adequacy, safety, and compliance with all applicable laws, ordinances, and regulations. All drilling and blasting shall be done in strict conformance to federal, state, and local requirements pertaining to this work and with materials and methods that assure the protection of persons and property. Any damage or injury to persons or property, including existing buried utilities or structures, resulting from rock excavation operations shall be the sole responsibility of the Contractor.

4. Whenever blasting is required, the Contractor shall conduct a pre-blast structure survey on all structures above and below ground within the affected area of his work that may be subject to blasting damage. The survey shall be conducted prior to the start of any blasting operation and shall include an area of at least 250 feet ahead, behind, and to the sides of any area to be blasted. The Contractor shall complete the pre-blast survey of all structures that could be affected by a particular blast a minimum of two (2) days prior to said discharge, and deliver a copy of the survey to the Engineer not later than one (1) day prior to the blasting operation. The Contractor also shall make every effort to keep the owners of structures that could be affected by a blast informed as to the timing of the discharges. However, it is the Contractor's responsibility to conduct the survey in a manner to ensure all structures having reasonable possibility of sustaining blast damage are included in the survey, irrespective of their proximity to blast site. The pre-blast structure survey shall be recorded on appropriate forms and may be supplemented by photographs, video tapes, tape recordings or other suitable methods of documentation. One copy of the form shall also be delivered to the Engineer no later than one (1) week after the survey is completed, unless required sooner as provided for above.
5. All blasts shall be recorded with one or more seismographs capable of recording the three components of motion. The Engineer shall be notified a minimum of two (2) hours prior to blast detonation. Seismographs shall be located proximate to the excavation site and adjacent to the closest sides of the closest structures (or wells) to the blast. The Contractor shall record the location, time, and ground vibration for each blast on a suitable documentation form and deliver a copy of the form to the Engineer no later than one (1) week after the blast is detonated.

3.04 TRENCH EXCAVATION SAFETY SYSTEM:

- A. The Contractor shall provide a Trench Excavation Safety System in compliance with all federal and state regulations. The safety system shall meet the provisions of the Washington Industrial Safety and Health Act, as set forth in the latest Revised Code of Washington (RCW), as required for trench excavations.
- B. Neither the Engineer nor the Owner will inspect, review, approve, or have any liability for the adequacy of the Contractor's Trench Excavation Safety System. Payment for the Trench Excavation Safety System will be made under a separate Bid Item. Payment for the Trench Excavation Safety System shall not be construed as acceptance or approval of the Contractor's Trench Excavation Safety System.
- C. The bid item for such Trench Excavation Safety System shall reflect the actual cost of providing the system. Bids received with a lower than actual cost may be judged non-responsive and, therefore, rejected.

3.05 LIMITS OF EXCAVATION:

- A. The length of trench excavated in advance of pipe laying shall be kept to a minimum and, in no case, shall exceed 150 feet, unless specifically approved by the Engineer.
- B. The trench shall be of sufficient width to permit proper assembly of the pipe and installation and compaction of bedding and backfill materials. Trench width at the surface of the ground shall be kept to the minimum necessary to install the pipe, but in full conformance with federal, state, and local safety requirements. Trench width shall also conform to applicable Drawing or Details.

3.06 EXCAVATION LINE AND GRADE:

- A. Trench excavation shall be made to the lines and grades indicated by the Drawings and Specifications and/or as established by the Engineer in the field, with proper allowance for all bedding or foundation replacement requirements. Unless specified otherwise in Section 01 01 00 or on the Drawings or Details, excavation shall allow for the installation of bedding material below the pipe as specified herein under 3.09 "Bedding Material Installation and Compaction". If the trench is excavated below the required grade at the option of, or error by, the Contractor, the trench bottom shall be brought back to grade with compacted bedding or foundation replacement material compacted in lifts to 95% density, as herein specified, at no additional cost to the Owner.
- B. Trench excavation planning and operation shall result in the installation of all pipe, appurtenances and structures in full conformance with the installation and testing requirements specified for the particular type of pipe, structure, and/or appurtenances for which the excavation is intended. In the case of water pipe or other pressure pipe installations, the trench shall provide for straight grades between vertical bends shown on the Drawings, with no localized high points. A depth deeper than the specified minimum excavation depth may be required to avoid such localized high points. In the case of gravity sewer pipes, the specified finished pipe grade and alignment will require exacting and careful trench excavation and workmanship to provide a firm trench bottom and pipe foundation. In all cases, a firm and unyielding trench bottom shall be provided for pipe, structure and appurtenance foundation.

3.07 UNSUITABLE FOUNDATION CONDITIONS:

Wherever trench excavation results in a trench bottom that contains voids, is saturated, soft, or is in any other way unsuitable for foundation in the opinion of the Engineer, such trench bottom material shall be removed to a depth approved by the Engineer and disposed of by the Contractor. Approved Foundation Stabilization Material shall be placed and compacted by the Contractor in lifts to a relative density of at least 95%, as herein specified.

3.08 CONTROL OF WATER:

- A. During excavation, installation of pipe, structures and appurtenances, backfill operations, and the placing and curing of concrete, all excavation areas shall be kept free of water except as otherwise specified or designated on the Drawings. The Contractor shall, at all times, control surface and subsurface drainage so as to prevent its entering the work. In no case shall the pipe or appurtenances being installed be used as a conduit to remove or transport surface or subsurface drainage.
- B. The Contractor shall furnish, install, and operate in such locations and, when necessary, such equipment and materials that are required to keep excavations free from water, and shall dispose of water without causing nuisance, damage, or injury to persons or property. He shall, at all times, have sufficient and reliable pumping equipment and pump drives on hand, in good working order, and operational, in spite of all ordinary emergencies, including power outages. He shall also have available, at all times, adequate and competent manpower to operate and maintain such equipment as necessary.
- C. The control of groundwater shall also prevent the softening of trench and excavation bottoms and dewatering materials, equipment, and methods shall prevent the removal of natural soils. Dewatering operations shall draw down subsurface water to a level at least 1 foot below the bottom of the

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excavation, result in the maintenance of the undisturbed state of foundation soils, and allow proper pipe, structure, and appurtenance installation, as well as the installation and compaction of all backfill materials to the specified density. Dewatering installation and operations shall not reduce the water level to the extent that it may damage or endanger other structures or improvements in the vicinity.

- D. Open and cased sumps shall not be used as primary dewatering methods for excavations deeper than 3 feet below the static water level.
- E. The release of groundwater to its static level shall be performed in such a manner as to maintain the undisturbed state of the foundation soils to prevent disturbance of compacted backfill materials and prevent flotation or movement of pipe, structures, or appurtenances.
- F. Unless a separate Bid Item is provided, all control of water and dewatering design, labor, materials, and equipment shall be considered incidental to trench excavation and no additional payment will be made therefore.

3.09 BEDDING MATERIAL INSTALLATION AND COMPACTION:

- A. The specified pipe bedding material shall be placed and compacted for all pipe, structures, and appurtenances. All bedding material shall be compacted to 95% relative density, as determined by ASTM D-1557, unless otherwise indicated in Section 01 01 00 or on the Drawings or Details.
- B. In addition to the requirements specified herein, all pipe backfill and compaction methods and equipment shall also conform to the pipe manufacturer's written installation instructions or manuals, which the Contractor shall have on the site. Water settling of the trench to attempt compaction shall not be allowed, unless specifically approved by the Engineer or indicated on the Drawings.
- C. Pipe bedding material shall be placed in the trench in such a manner as to protect the pipe and appurtenances from movement or damage. In general, material shall be placed into the trench by pushing it from the end of the trench at an angle along and over the pipe so that the material is placed in the form of a rolling slope rather than by side filling. Free falling material shall not be allowed to fall directly on the pipe.
- D. Unless specified otherwise in Section 01 01 00 or on the Drawings or Details, a minimum of 4" of bedding material shall be installed under the pipe where no rock exists in the trench bottom and a minimum of 6" under the pipe where the trench bottom is in rock. The trench bottom and bedding shall be hand-graded and compacted to provide uniform and continuous support for the full length of the pipe. Depressions in the bedding shall be hand-formed to allow proper assembly of the pipe. Care should be taken to make the depression no larger than necessary, and to hand-fill and compact bedding material into and around the pipe bell to provide adequate support of the pipe and pipe joint.
- E. Bedding material shall be placed in maximum 8" lifts to the spring line of the pipe, taking care to adequately place and compact the material for the full width of the trench to the specified density, under and around the pipe on both sides evenly, and for its full length, so as to provide adequate lateral pipe support and strength without altering its proper grade and alignment. T-bars of proper weight and shape shall be used for hand-compacting bedding material under and around the pipe, taking necessary precautions to prevent movement of the pipe during the operation.
- F. After placement and compaction of bedding material to the pipe spring line, additional bedding material shall be placed and compacted in sufficient lifts to obtain the specified compaction. Unless

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specified otherwise on the Drawings or in Section 01 01 00, bedding material shall be placed and compacted to a depth of at least 12" above the pipe and for the full width of the trench.

- G. Bedding and/or side support material that is disturbed by removal or moving the trench excavation safety system shall be re-compacted to specified density before proceeding with backfilling.

3.10 TRENCH BACKFILL AND COMPACTION:

- A. Unless indicated otherwise on the Drawings, all trench backfill in roadway and other surfaced areas shall be compacted to at least 92% of maximum density, as determined by AASHTO T-180, except the top 2' of backfill under paved areas shall be compacted to 95%. Trench backfill in other areas shall be compacted to at least 90% of maximum density, as so determined. All trench backfill material shall be as specified herein.
- B. The Contractor shall not side fill the trench with backfill material until at least 2' of bedding and backfill material has been placed and compacted. Trench backfill material, as specified, shall be placed and compacted in lifts to the specified density. The Contractor shall select and use compaction equipment such that the pipe and appurtenances are not moved or damaged in any way. In general, heavy self-propelled equipment shall not be operated in the trench until at least 3' of backfill has been placed and compacted.

3.11 BACKFILL SETTLEMENT:

Settling of any trench within one year after final acceptance of the work shall be considered incontrovertible evidence of inadequate compaction. Upon notification of such settlement, the Contractor shall promptly perform such remedial work as may be required to correct the deficiency to the satisfaction of the Owner, including replacement of surfacing materials, at no additional cost to the Owner. If such remedial work is not promptly performed, the Owner may exercise its rights as holder of the required performance bond and make such repairs as it deems fit, recovering the resulting expenses from the bond surety.

3.12 RESTORATION, FINISHING AND CLEAN-UP:

The Contractor shall restore, replace, or repair such surfaces, structures, and improvements as may have been disturbed, removed, or damaged as a result of his operations. All such items shall be returned to a condition equal to that before the work began and to the satisfaction of the Owner. All surplus and waste materials shall be removed and surfaces cleaned. Of particular importance are existing drainage facilities and ditches, which shall be carefully and completely restored to their intended function as soon as possible after disturbance, even if all other work in the area is still under way. Partial or final payments may be withheld if required restorations, repairs, finishing and clean-up are not satisfactorily completed.

3.13 TRENCH BACKFILL SURFACE MAINTENANCE:

- A. Unless required otherwise on the Drawings or specified elsewhere in the Specifications, temporary trench backfill surface restoration and maintenance shall be as required in this paragraph and performed at no additional cost to the Owner.
- B. The Contractor shall diligently and continuously maintain temporary trench surfaces after backfill to provide smooth and firm traffic surfaces, where required, until permanent surfacing is placed. This

maintenance may include placement of crushed rock, oil, and/or temporary pavement materials to keep traffic areas smooth. Dust control shall also be performed as required.

- C. Temporary surfaces shall be maintained by the Contractor until the following operations and items, as required, have been completed and approved by the Engineer:
1. Installation of service connections, lines and appurtenances
 2. Installation of valve boxes, cleanouts, manholes and other surface features
 3. Pipeline, manhole and other testing
 4. Clean-up and restoration of all other physical features
 5. Restoration and repair of disturbed utilities as required
- D. No permanent pavement or other surface replacement or repair shall be undertaken until the above items have been satisfactorily completed and approved by the Engineer.

4.00 MEASUREMENT AND PAYMENT

4.01 GENERAL:

- A. See Section 01 22 00 - Measurement and Payment for General Requirements. See Section 01 01 00 - Special Requirements/Bid Items for possible modifications to Standard Bid Items.
- B. If no specific bid item is provided, measurement and payment shall be considered incidental and shall be included in the bid price for other items of work for the project.

4.02 BID ITEMS:

- A. Special provisions, requirements, revisions to these Bid Items, and/or additional Bid Items, may be included in Section 01 01 00 (green pages) or on the Drawings or Details.
- B. Trenching, Bedding and Backfill
1. This Bid Item shall include all trench excavation, bedding, backfilling and compaction, including placing and compacting, not furnishing, imported bedding and backfill material if required. It shall include transporting and disposing of excess trench excavation material not included in other bid items provided, and finish grading.
 2. Measurement and Payment shall be per Lineal Foot (L.F.), as measured along the installed pipe by the Engineer. Measurement shall be made through fittings, valves, connection details, manholes and clean-outs, as applicable.

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C. Furnish Imported Trench Backfill

1. This Bid Item shall include furnishing only (not placing or compacting) imported trench backfill material, in conformance with the applicable material specifications. Also included shall be transporting imported material to the site and transporting and disposing of excess trench excavation material resulting from utilization of imported backfill.
2. Measurement and Payment shall be on a unit price per Cubic Yard (C.Y.) or per Lineal Foot (L.F.), as measured by the Engineer along the installed pipe where imported backfill is placed at the direction of the Engineer. Imported material will be paid for only at the locations where its use is required by the Engineer, or specifically identified on the Plans or elsewhere on these specifications.

D. Trench Foundation Stabilization

1. Includes extra excavation of unsuitable material, furnishing, placing and compacting foundation stabilization material. Also included shall be transporting and disposing of excess excavation material resulting from utilization of imported backfill.
2. Payment shall be made on a unit price Cubic Yard (C.Y.) or Lineal Foot (L.F.) basis, as measured by the Engineer. Trench foundation stabilization shall be paid for only at locations where its use is required by the Engineer or specifically identified on the Plans.

E. Furnish Pipe Bedding

This Bid Item shall include furnishing only (not placing or compacting) bedding material, in conformance with the applicable material specifications. Material may be screened on-site or off-site and imported. Also included in this Bid Item shall be transporting imported bedding material to the site (if required), and transporting and disposing of excess trench excavation material resulting from utilization of imported bedding. Measurement and payment will be on a Lineal Foot (L.F.) basis, as measured to the nearest foot by the Engineer in the field along the installed pipes where bedding is placed. Imported (or screened on-site) bedding material shall be used for all pipe, unless specifically indicated otherwise in the field by the Engineer or specifically identified otherwise on the Plans or elsewhere in the specifications.

F. Trench Excavation Safety System

This Bid Item shall include furnishing and implementing a Trench Excavation Safety System in conformance with the applicable codes and specifications. Measurement and payment will be on a Lump Sum (L.S.) basis or on a Lineal Foot (L.F.) basis, as measured to the nearest foot by the Engineer in the field along the trench in which excavation exceeds a depth of 4 feet and where such safety system is actually used.

G. Rock Excavation

1. When included as a Bid Item, rock drilling and blasting or hoe ramming shall include all work necessary for using pneumatic equipment (“hoe ramming”) or systematically drilling and blasting boulders (larger than 1.0 cubic yard), ledge rock, or other solid rock formations to allow excavation of the pipeline trench as specified herein. Removing, hauling and disposal of oversize,

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unsuitable, or excess material resulting from rock drilling and blasting or hoe ramming shall be considered incidental and no separate payment will be made therefore. Furnishing imported trench backfill shall be considered incidental and no separate payment will be made unless a separate Bid Item is included for imported backfill. Excavation and backfill operations are included in other Bid Items. Boulders smaller than 1.0 cubic yards shall not be classified as rock requiring rock drilling and blasting or hoe ramming.

2. Measurement and Payment shall be per Cubic Yard (C.Y.) or Lineal Foot (L.F.) of drilled and shot rock or pneumatically fractured rock as indicated on the Bid Form, as measured in place by the Engineer. No drilling and blasting or hoe ramming of rock will be paid for without prior approval by the Engineer that such operations are required. Measurement and payment limits on a C.Y. basis shall not extend beyond the width of the trench bottom or beyond the actual vertical dimensions of rock within the trench. The width of the trench bottom for determining the basis of payment shall be 36" unless specified otherwise in Section 01 01 00. Vertical distances shall be measured from the upper surface of the rock as defined in Paragraph 3.03 C "Rock Excavation", to an elevation 6 inches below the underside of the pipe barrel. Measurement and payment on a L.F. basis shall be for the length of pipe trench where rock drilling and blasting or hoe ramming occurred, not including trench portions where rock was not encountered. All fixed costs for this Bid Item, including pre-blast surveys, shall be included in this Bid Item.

****END OF SECTION****

1.00 GENERAL

1.01 DESCRIPTION:

- A. This Section includes the work necessary to replace, and restore as required by these Specifications, directed in the field, or as indicated on the Drawings, all pavement, gravel surfacing, curbs, curb and gutters, and sidewalks damaged either directly or indirectly by the Contractor's operations. It shall also include installation of new pavement, gravel surfacing, curbs, curb and gutters, and sidewalks as indicated on the Drawings or as directed in the field by the Engineer.
- B. Special provisions, requirements and/or revisions to this Specification and/or Bid Item(s) may be included in Section 01 01 00 (green pages) and/or on the Drawings or Details.
- C. See also Sections 31 00 00 "Earthwork" and/or 31 23 00 "Trench Excavation, Backfill and Compaction", if included, for related surface removal specifications. See also Section 32 11 33 Cement Treated Base, if included.

1.02 QUALITY ASSURANCE:

All materials shall comply with the latest version of the WSDOT Standard Specifications for Road, Bridge and Municipal Construction and the current Amendments.

1.03 SUBMITTALS:

Submittals shall conform to Section 01 33 00 of these Specifications and shall include test results and samples, as indicated herein.

2.00 PRODUCTS

2.01 CRUSHED SURFACING:

- A. The material shall consist of uniform quality, clean, tough, durable fragments of rock or gravel, free from flat, elongated, soft or disintegrated pieces and other objectionable matter. Material shall meet the requirements of crushed surfacing specified in WSDOT Standard Specifications and Amendments.
- B. Test results, or other evidence satisfactory to the Engineer, shall be provided by the Contractor to show that the proposed material meets the requirements prior to material delivery to the project. Provide a physical sample if requested by the Engineer.
- C. Base course and top course material shall comply with the following sieve analysis:

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SIEVE SIZE	% PASSING BY WEIGHT	
	Base Course	Top Course
1-1/4" square	100	
1" square	80-100	
3/4" square		100
5/8" square	50-80	
1/2" square		80-100
U.S. No. 4	25-45	46-66
U.S. No. 40	3-18	8-24
U.S. No. 200	7.5 max	10.0 max

2.02 ASPHALT CONCRETE (HMA):

All asphalt concrete shall be hot plant-mixed asphalt (HMA). Mix design, components and installed HMA shall be in compliance with current WSDOT Standard Specifications as amended in the APWA GSP, of the class(es) shown on the Bid Form.

HMA for pre-leveling shall be CL 3/8: PG 64-28 unless specified otherwise on the Drawings or in Section 01 01 00.

2.03 ASPHALT PRIME (TACK COAT):

Asphalt prime coat shall be liquid CSS-1 or RC-250 emulsified asphalt or approved equal.

2.04 CONCRETE:

Concrete for curbs, sidewalks, driveways, and other items shall be Portland cement concrete with a minimum 28 day compressive strength of 3,500 psi, no less than 5-1/2 sacks of cement per cubic yard, and a maximum 3" slump. All concrete shall be air entrained (5%).

2.05 EARLY STRENGTH CONCRETE APPROACH:

Where called for in Section 01 01 00 or on the Drawings or Details, early strength concrete driveway approaches shall conform to WSDOT Section 5-05.3(18) for Cement Concrete Approach, including Section 5-05.3(17) for Opening to Traffic. Typically, these are called out as "Cement Concrete Approach [3, 7, or other]-Day."

3.00 EXECUTION

3.01 GENERAL:

- A. The Engineer and Owner reserve the right to vary the type of surfacing as may best serve the interests of the Owner.
- B. All Portland cement concrete sidewalks, curbs, driveways and other surfaces shall be formed, placed, consolidated and finished to provide a high quality dense finished surface with the type of finish appropriate for the type of surface. All dimensions shall be accurate, all edges straight and true, and all surfaces free of depressions or high points. All work shall match thickness, elevation and dimensions of existing adjoining surfaces.

- C. Unless otherwise shown on the Drawings, all surfaces damaged by the Contractor's operations shall be repaired or replaced by the Contractor. In addition to the requirements of this Section, all work shall conform to the applicable requirements of WSDOT Standard Specifications and Amendments, and local town and county standards.

3.02 INTERIM SURFACE MAINTENANCE:

A. Dust Control

The Contractor's attention is directed to Section 01 10 00 regarding dust control requirements. Following backfill and compaction, excavated areas shall be finish graded level with existing surfaces. Adjacent pavement areas shall be brushed and washed down to remove all soil and rocks. The Contractor shall maintain all backfilled areas to provide a smooth travel surface free of holes, soft spots and rocks. Apply water, dust-palliative or oil as required to adequately control dust as approved by the Engineer or Owner.

B. Maintenance Schedule

All temporary surfaces shall be maintained and repaired regularly by the Contractor as required to provide a smooth, dust-free roadway surface. During adverse weather, the Contractor shall inspect and repair temporary surfaces weekly.

C. Special Areas

Pavement replacement in driveways and parking areas shall be done within one (1) week of completion of backfill, unless specific authorization is given otherwise by the Owner or Engineer. All surface restorations in pedestrian traffic areas shall be made as soon as possible after backfill, in no case later than five (5) days after backfill, unless specific authorization is provided otherwise. In the interim, all driveways, parking areas, and pedestrian traffic areas shall be finished with a minimum 2" of compacted crushed rock base course material temporary surface.

D. Roadways

1. When pavement replacement in roadways is not made within three (3) weeks following backfilling, interim surfacing shall be provided as follows:
 - a. All excess material shall be removed and adjacent surfaces washed and broomed. The unpaved area shall be given an application of RC-250 asphalt at the rate of 0.2 to 0.3 gallons per square yard, and sufficient aggregate for a "blotter", which shall serve as temporary pavement replacement until such time as permanent pavement is placed.
 - b. The temporary surface shall be maintained and repaired as required until the permanent surface is placed.
 - c. Temporary fill shall be removed as required for installation of permanent surfacing. The Contractor shall be responsible for the proper disposal of all waste material. Such material shall be disposed of at a site procured by the Contractor. The Contractor shall receive prior approval from all applicable local and state agencies, regarding his operations and methods, prior to disposing of waste material.

2. All costs for all temporary surfacing and its maintenance and removal shall be considered incidental and shall be included in the cost for bid items of work provided.

3.03 ASPHALT CONCRETE (HMA) PAVEMENT:

A. Requirements

All HMA mix design(s), materials, submittals, preparation, placement, compaction and finished surfaces shall comply with the current edition of WSDOT Standard Specifications as amended by the APWA GSPs.

B. Subgrade

Prepare subgrade as specified to a smooth even grade at the specified compaction and at the proper grade for installation of the specified thickness of permanent surfacing materials. Trim existing pavement edges to a straight and vertical edge with a pavement saw or cutter. Remove all damaged, lifted or otherwise unsound remaining pavement to provide a sound edge for joining new pavement.

C. Crushed Surfacing

Place crushed surfacing base course and top course material to the depth required as specified in the Drawings or in Section 01 01 00 of these Specifications, but in no case less than 4” total depth, and compact to 95% maximum density to provide a smooth unyielding surface.

D. Cement Treated Base (CTB)

If included in the project, CTB shall be placed in accordance with Section 32 11 33 to the specified depth, width, lines and grades.

E. Tack Coat

After crushed surfacing top course has been graded and compacted, and just prior to placing asphalt pavement, apply an asphalt tack coat to all existing pavement edges, valve boxes, manhole covers, curb faces and other appurtenances in the area to be paved.

F. HMA Pre-Leveling

Place an HMA pre-leveling course where shown on the Drawings and/or in Section 01 01 00. If not specifically shown, place a pre-level course where necessary to result in a finished final pavement surface that complies with these specifications.

G. HMA Placement and Compaction

1. Place asphalt concrete on the prepared crushed surfacing to a required depth, as specified in the Drawings and/or in Section 01 01 00, and/or on the Bid form, but in no case less than 2” except for pre-leveling. The nominal compacted depth of any layer of any course shall not exceed the depth as specified in the WSDOT Standard Specifications and Amendments. Spread and level with hand tools or a mechanical spreader as required by the area to be paved. Bring asphalt to proper grade and compaction by rolling or the use of adequate hand

tampers where rolling is impossible or impractical. Asphalt concrete shall be compacted to a minimum 92.0% Rice Density.

2. Unless specified otherwise, the required total depth of HMA shall not include pre-leveling course.
3. Power rollers shall provide 200 to 300 pounds per lineal inch. Begin rolling from the outside edge of the replacement pavement and work toward the existing pavement, lapping ½ width of the roller.
4. The finished surface shall be a dense, thoroughly compacted pavement which is hard, smooth, free of roller marks, and shows no appreciable movement under the roller wheels or compactor. It shall be unyielding, true to thickness and grade, free draining and conform to the grade specified and/or crown of the adjoining existing pavement, with no irregularities.

H. Weather Conditions

Asphalt shall not be applied to saturated material, or during rain, snow, sand or dust storms, or any imminent storms that may adversely affect the finished pavement. Asphalt shall not be placed when:

1. the atmospheric temperature is less than 40 degrees F
2. during heavy rainfall, or
3. when the surface upon which it is to be placed is frozen.

I. Protection of Structures

Provide any coverings necessary to protect exposed existing structures or improvements of any nature from splashing oil and asphalt. Remove any asphalt or oil that gets on or in such structures or improvements. Conduct all compaction operations in such a manner and with care to avoid damage to existing structures and improvements.

J. Locating and Adjusting Manholes, Drywells, Catch Basins and other Utilities to Grade

The Contractor shall locate and adjust frames and covers or grates for all existing utility structures including: sanitary manholes, drywells, storm manholes, catch basins, grate inlets, survey monuments, water valve boxes and any other utility or item(s) requiring adjustment to final grade.

The existing cast iron ring and cover on manholes and catch basin and inlet frame and grate shall first be removed and thoroughly cleaned for reinstalling at the final elevation. From that point, the existing Structure shall be raised or lowered to the required elevation. The materials and method of construction shall conform to the requirements specified herein, and the Structure shall conform to the requirements of the WSDOT Standard Plans except as approved by the engineer. In the event the all or portions of the existing structure(s) are damaged, or if directed by the Engineer, all or portions of the structure shall be replaced at the material cost of the new structure or at no cost if replacement structure(s) are provided by the Owner.

Precast concrete adjustment rings shall be used in manhole construction. Final adjustment shall be made using waterproof non-shrink grout, mortar or metal shims. Polyethylene adjustment rings may also be used, subject to the acceptance of the Engineer.

The Contractor shall set the rim elevations at 1/4-inch to 3/8-inch below the surrounding final pavement or ground elevation. All adjustment rings, concrete bricks or shims shall be mortared in place. The adjustment section shall then receive coating of waterproof non-shrink mortar grout on the outside with the mortar struck off and pointed on the inside. The casting shall also be set in mortar.

Warping of grades in lieu of manhole frame adjustment shall not be allowed. Joints in the brick or ring adjustment shall be filled with grout. The castings shall be seated in grout placed on the top course. A 3/8-inch thick mortar lining shall be installed inside and out of the adjustment section to provide a smooth, watertight finish.

Rings and frames shall be placed on common brick or cement concrete adjusting rings, bound with mortar, and wedged up to the proper grade. Mortar alone shall not be used. Debris shall not be deposited in the sewer, drainage structure, valve vault, or other similar structure from this operation. Debris shall be removed at Contractor's own expense.

The metal ring or frame on manholes, catch basins, and similar structures within areas of asphalt pavement construction or resurfacing shall be adjusted prior to placing the top lift of asphalt (wearing course).

Adjustments of all utility castings shall be made in the same manner as manholes and catch basins. If no specific bid item is provided adjustment of utilities to grade is considered incidental.

K. Curb Exposure

1. The Contractor shall maintain 6" curb exposure.
2. Where existing grade is adjusted to obtain required curb exposure, Contractor shall be responsible to maintain existing drainage characteristics throughout the project, although occasional grade revisions may be required to improve drainage and shall be considered incidental to the work.
3. Where existing curb has irregular grade, pavement shall be placed to result in uniform grade with minimum curb exposure of not less than 3".

L. Surveying Requirements

The Contractor shall utilize a licensed surveyor to re-establish roadway sections and adjust finished grade elevations to accommodate curb exposure, street cross slope requirements and maintain drainage characteristics.

M. Pavement Marking

Contractor shall place temporary spotting or completely re-establish lane markings immediately after pavement replacement. All pavement marking (lane marking, crosswalks, parking markings, etc.) shall be permanently re-established with five (5) days of pavement restoration.

N. Excess Materials

Dispose of all excess and waste materials in full accordance with local and state requirements and as specified in these Contract Documents.

O. Responsibility for Settlement of Surfaces

Settlement of resurfaced areas within the warranty period shall be the sole responsibility of the Contractor. The Contractor shall promptly repair all such areas upon notification from the Engineer or Owner at no additional cost.

3.04 CONCRETE DRIVEWAYS, SIDEWALKS AND CURBS:

- A. The Contractor shall replace portland cement concrete driveways, sidewalks and curbs to the same section, width, depth, line and grade as that removed or damaged, or as specified in the Drawings and Details. Edges shall be sawcut straight and vertical. Compaction shall be adequate to prevent settlement.
- B. Form construction, placement and finish of concrete shall result in finished work that matches the existing surfaces. Replace concrete between scored or expansion joints, and make replacements to minimize a patched appearance.
- C. Provide a 4” thick compacted base course of crushed rock. Place concrete to the same thickness as the existing or as specified in the Drawings, but not less than 4”. Provide score joints with steel finishing tool, and a full depth expansion joint at adjoining edge with existing concrete.
- D. New concrete driveway, sidewalk, curb and gutter installations shall conform to applicable portions of the above requirements and as specified on the Drawings and Details.

3.05 ASPHALT DRIVEWAYS, SIDEWALKS AND PARKING AREAS:

Asphalt driveways, sidewalks and parking areas shall be replaced as specified above for asphalt concrete pavement.

3.06 GRAVEL SURFACE PLACEMENT:

Replace all existing gravel or crushed rock surfaces and/or place new gravel surfaces as shown on the Drawings with crushed rock as specified for crushed surface base course and top course, to a depth of 4” or as shown on the Drawings. Grade smooth and compact to blend smoothly with adjacent areas.

4.00 MEASUREMENT AND PAYMENT

4.01 GENERAL:

- A. See Section 01 22 00 – Measurement and Payment for General Requirements. See Section 01 01 00 – Special Requirements/Bid Items for possible modifications to Standard Bid Items. If no specific bid item is provided, measurement and payment shall be considered incidental and shall be included in the provided Bid Items.

- B. Payment for surface improvements or surface restoration Bid Items shall be at locations indicated on the Drawings. No additional payment will be made for restoring surfaces damaged outside of the indicated payment areas. Interim surface and surface maintenance as specified shall be included in all Bid Items as applicable.

Surface restoration, gravel surface replacement other than that specifically provided for in a Bid Item below, fine grading and clean-up of gravel, unimproved or dirt areas shall be considered incidental and the cost shall be included in the provided Bid Items.

4.02 BID ITEMS:

- A. Special provisions, requirements, revisions to these Bid Items, and/or additional Bid Items, may be included in Section 01 01 00 (green pages) or on the Drawings or Details.

B. AC Pavement Removal

This Bid Item shall include removal of all existing asphaltic pavement of any type and as indicated on the Drawings or required in the field, including pavement cutting, removal of excess material to a depth to accommodate gravel base and pavement replacement as indicated on the Drawings or in other Bid Items, and hauling away and disposing of removed material. It shall include interim surface maintenance as applicable and required. Measurement and payment shall be on square yard (S.Y.) basis, as measured in the field by the Engineer.

C. AC (HMA) Pavement Placement

This Bid Item shall include furnishing, placing, compacting and finishing the specified crushed surfacing base and top course and asphalt concrete (HMA) pavement to the depths indicated in the Bid Item, Specifications or on the Drawings. Where CTB is constructed it is paid for under other Bid Items (see Section 32 11 33). Measurement and payment shall be on a unit price square yard (S.Y.) basis, as measured in the field by the Engineer. Placement of gravel shoulder on roadways without curb, where required, is not included in this Bid Item.

If no separate AC Pavement Removal or Asphalt Pre-Leveling bid items are provided, no separate payment will be made and cost for same shall be included in the provided Bid Items.

D. Asphalt Pre-Leveling

This Bid Item shall include furnishing, placing and compaction of HMA pre-leveling course where shown on the Drawings and/or in Section 01 01 00, or if not specifically shown, place a pre-level course where necessary to result in a finished pavement and surface that complies with these specifications. Measurement and payment shall be on a unit price square yard (S.Y.) basis as measured in the field by the Engineer. If no Asphalt Pre-Leveling Bid Item is provided, the cost for same shall be included in the AC (HMA) Pavement Placement Bid Item.

E. Integral Curb and Sidewalk Removal

Bid Item shall include removing and disposing of existing integral curb and sidewalk including saw cutting, in accordance with these Contract Documents. It shall include interim surface maintenance as applicable and required. Measurement and payment shall be made on a unit price lineal foot (L.F.) basis. Measurement shall be the horizontal distance measured along the face of the curb. Payment for removal of curb and sidewalk associated with utility service lateral

installations will be limited to a maximum of 15 lineal feet per sewer service installation and 10 lineal feet per water service installation. Payment for removal of wheel chair ramps shall be included in this bid item for integral curb and sidewalk or separate curb and sidewalk bid items as applicable.

F. Integral Curb and Sidewalk Placement

Bid Item shall include placing integral curb and sidewalk including finishing, base course, concrete, and incidentals necessary to complete this item in accordance with these Contract Documents. Measurement and payment shall be made on a unit price lineal foot (L.F.) basis. Measurement shall be the horizontal distance measured along the face of the curb. Payment for replacement of curb and sidewalk associated with utility service lateral installations will be limited to a maximum of 15 lineal feet per sewer service installation and 10 lineal feet per water service installation. Payment for wheel chair ramps shall be included in this bid item for integral curb and sidewalk or separate curb and sidewalk bid items as applicable.

G. Integral Curb and Driveway Apron Removal

Bid Item shall include removing and disposing of existing integral curb and driveway including saw cutting, in accordance with these Contract Documents. It shall include interim surface maintenance as applicable and required. Measurement and payment shall be made on a unit price lineal foot (L.F.) basis. Measurement shall be the horizontal distance measured along the face of the curb. Payment for removal of curb and driveway associated with utility service lateral installations will be limited to a maximum of 15 lineal feet per sewer service installation and 10 lineal feet per water service installation.

H. Integral Curb and Driveway Apron Placement

Bid Item shall include placing integral curb and driveway including finishing, base course, concrete, and incidentals necessary to complete this item in accordance with these Contract Documents. Measurement and payment shall be made on a unit price lineal foot (L.F.) basis. Measurement shall be the horizontal distance measured along the face of the curb. Payment for replacement of curb and driveway associated with utility service lateral installations will be limited to a maximum of 15 lineal feet per sewer service installation and 10 lineal feet per water service installation.

I. Concrete Curb Removal

This Bid Item shall include removing and disposing of existing concrete curb only, whether or not a sidewalk exists. It shall include saw cutting, in accordance with these Contract Documents. It shall include interim surface maintenance as applicable and required. Measurement and payment shall be on a unit price lineal foot (L.F.) basis. Measurement shall be the horizontal distance measured along the face at the curb. Payment for removal of curb associated with utility service lateral installations will be limited to 15 lineal feet per sewer service installation and 10 lineal feet per water service installation. Payment for curb only (not integral with sidewalk) removal associated with driveway aprons or wheel chair ramps shall be included in this Bid Item.

J. Concrete Curb Placement

This Bid Item shall include placing concrete curb only, whether or not a sidewalk exists. It shall include finishing, base course, concrete and incidentals necessary to complete this item in accordance with these Contract Documents. Measurement and payment shall be on a unit price lineal foot (L.F.) basis. Measurement shall be the horizontal distance measured along the face at the curb. Payment for replacement of curb associated with utility service lateral installations will be limited to 15 lineal feet per sewer service installation and 10 lineal feet per water service installation. Payment for curb only (not integral with sidewalk) placement associated with driveway aprons or wheel chair ramps shall be included in this Bid Item.

K. Concrete Curb and Gutter Removal

This Bid Item shall include removing and disposing of existing concrete curb and gutter only, whether or not a sidewalk exists. It shall include saw cutting, in accordance with these Contract Documents. It shall include interim surface maintenance as applicable and required. Measurement and payment shall be on a unit price lineal foot (L.F.) basis. Measurement shall be the horizontal distance measured along the face at the curb. Payment for removal of curb and gutter associated with utility service lateral installations will be limited to 15 lineal feet per sewer service installation and 10 lineal feet per water service installation. Payment for curb and gutter only (not integral with sidewalk) removal associated with driveway aprons or wheel chair ramps shall be included in this Bid Item.

L. Concrete Curb and Gutter Placement

This Bid Item shall include placing concrete curb and gutter only, whether or not a sidewalk exists. It shall include finishing, base course, concrete and incidentals necessary to complete this item in accordance with these Contract Documents. Measurement and payment shall be on a unit price lineal foot (L.F.) basis. Measurement shall be the horizontal distance measured along the face at the curb. Payment for replacement of curb and gutter associated with utility service lateral installations will be limited to 15 lineal feet per sewer service installation and 10 lineal feet per water service installation. Payment for curb and gutter only (not integral with sidewalk) placement associated with driveway aprons or wheel chair ramps shall be included in this Bid Item.

M. Concrete Flatwork Removal

This Bid Item includes saw cutting (if needed), removal and disposal of miscellaneous concrete flatwork including sidewalks, driveways, aprons and concrete slabs as specified on the Drawings or approved in the field by the Engineer. Measurement and payment shall be made on a unit price square yard (S.Y.) basis as measured in the field by the Engineer. This item does not include curb, curb and gutter, integral curb/ sidewalk or curb/driveway that are included in previous Bid Items.

N. Concrete Flatwork Placement

This Bid Item includes placement of miscellaneous concrete flatwork including sidewalks, driveways, aprons and concrete slabs as specified on the Drawings or approved in the field by the Engineer. Measurement and payment shall be made on a unit price square yard (S.Y.) basis as measured in the field by the Engineer. Base course gravel for slabs is incidental to this item and

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separate payment is not made. This item does not include curb, curb and gutter, integral curb/sidewalk or curb/driveway that are included in previous Bid Items.

O. Gravel Surface Placement

This Bid Item shall include furnishing, placing, compacting and finishing crushed rock surfacing in roadway, driveway and other areas to replace existing crushed rock disturbed during construction, and/ or new areas as indicated on the Drawings. Payment will be on a unit price cubic yard (C.Y.), square yard (S.Y.) or on a lump sum (L.S.) basis. This Bid Item also includes gravel surfacing of shoulders as are adjacent to paved roads without curbs and as approved by the Engineer. This Bid Item does not include crushed surfacing as base or top course under asphalt.

P. Cement Concrete Approach - () Day

This Bid Item shall be as specified above for Integral Curb and Driveway Apron Placement.

Q. Locate and Adjust Existing Manhole, Catch Basin or Drywell

This Bid Item shall be measured per each (EA) and shall be full payment for furnishing all tools, labor, equipment, and materials to locate, inventory, lower and protect existing structures prior to excavation or construction of CTB or other base and surfacing as needed and adjust existing structures to finished grade.

Work includes but is not limited to: locating and inventorying structures, structure excavation Class B including haul, interim adjustments up or down as may be required, excavation, removal and safely storing existing structures or components for re-installation as applicable, backfilling, compaction, protection of structures, provisions for continued street drainage, base replacement and pavement patching, surfacing and restoration of adjacent areas and removing construction debris after construction is complete, all in accordance with the Drawings and specifications.

When no Bid Item is provided on the Bid Form this work is considered incidental to the project and no payment shall be made.

R. Locate and Adjust Existing Valve Box

This Bid Item shall be measured per each (EA) and shall be full payment for furnishing all tools, labor, equipment, and materials to locate, inventory, lower and protect existing water valve boxes prior to excavation or construction of CTB or other base and surfacing as needed and adjust existing valve boxes to finished grade.

Work includes but is not limited to: locating and inventorying structures, structure excavation Class B including haul; interim adjustments up or down as may be required, excavation, removal and safely storing existing structures or components for re-installation as applicable, backfilling, compaction, protection of structures, provisions for continued street drainage, base replacement and pavement patching, surfacing and restoration of adjacent areas and removing construction debris after construction is complete, all in accordance with the Drawings and specifications.

SURFACE IMPROVEMENTS AND RESTORATION

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When no Bid Item is provided on the Bid Form this work is considered incidental to the project and no payment shall be made.

Water valve box adjustment for new valves is included in payment for valves. See Section 40 00 00b.

****END OF SECTION****

1.00 GENERAL

1.01 DESCRIPTION:

- A. The work of this section consists of furnishing and installing standard industrial type chain link fencing with fabric height of 6 to 12 ft., with or without barbed wire and swing gates (if required) with leafs from 6 to 12 ft. wide.
- B. Where required, chain link fence shall be installed as shown on the drawings and as described below.
- C. Special provisions, requirements and/or revisions to this Specification and/or Bid Item(s) may be included in Section 01 01 00 (green pages) and/or on the Drawings or Details.

1.02 QUALITY ASSURANCE:

Contractor shall only use personnel who have been completely trained and are experienced in the installation of the type of fencing specified. All materials shall be new.

1.03 SUBMITTALS:

Certification of quality, weights and dimension of all materials. Submittals shall conform to Section 01 33 00 of these specifications.

2.00 PRODUCTS

2.01 FENCING MATERIALS:

Standard commercial products which meet the general requirements of these Specifications and vary only in non-essential details will be acceptable. All steel materials specified herein shall be hot dipped galvanized after fabrication or weaving. Zinc used for galvanized coating shall conform to ASTM B6 for slab zinc and the weight of coating shall be determined in accordance with the method described in ASTM A90.

A. Fencing/Wire

- 1. Fabric to be installed to the various heights as shown on the drawings. All wire shall be No. 9 gauge (0.148" diameter) steel, galvanized after weaving, 1.2 oz. Zinc per sq. ft. woven in 2-inch mesh. Fabric shall be class 1, per ASTM A-392. Fabric wire shall be 80,000 psi min.
- 2. Type of fabric selvage (knuckled or twisted) shall be as appropriate for the particular fence location and purpose and as approved by the Engineer.
- 3. Bottom tension wire shall be 7 ga. coil spring and shall be attached to the fence fabric every 24" with hog rings.
- 4. Barbed wire, if required as noted on the Drawings or Details, shall be two-strand twisted No. 12-½ ASW gauge galvanized steel wire with two-point barbs of 14 ASW gauge galvanized steel wire conforming to ASTM A-121. Barbs shall be spaced five inches apart. Installation of barbed wire shall be on arms bent at 45°, attached at the top of the fence.

5. Stretcher bars used to attach fabric to terminal posts shall be $\frac{3}{4}$ " x $\frac{1}{4}$ " steel, attached to posts with $\frac{1}{8}$ " by 1" (nominal) wide plain edge bands at 14" o.c.
6. Wire clips for attaching fabric to posts and rails shall be 9 ga. Class 1 galvanized or aluminum wire.

B. Posts/Rail

1. Posts, braces, rails and gate frames shall conform to the requirements of ASTM F-1083 or 1043 and shall have a minimum average zinc coating of 1.8 oz./ft².
2. Line post shall be 2-3/8" O.D., Schedule 40, galvanized pipe, length as required, 3.65 lb. per ft.
3. Corner, end and pull post shall be 2-7/8" O.D. Schedule 40 galvanized pipe, to lengths as shown on drawings, 5.79 lb. per ft.
4. Corner, end and pull post shall extend 36" into concrete foundations; gate posts shall be 42" deep.
5. Top rail and brace members, when required, shall be 1-5/8" O.D., 140" wall pipe, 2.27 lb. per ft. Truss assembly shall consist of a minimum 3/8" diameter truss rod with a turnbuckle or other equivalent provision for adjustment.
6. All posts shall have tops which prevent moisture from entering.

C. Gate

1. Drive gates shall be two piece center latching swing gates, width as indicated on Drawing. They shall conform to ASTM F-900.
2. Drive gate posts shall be 4-inch minimum O.D. tubular steel, Schedule 40, 9.10 lb. per foot.
3. Drive gate frame shall have 1-7/8" O.D. frame, Schedule 40, 2.72 lb. per foot.
4. Drive gate hinges shall be Bulldog Industrial Hinge F15674 as manufactured by Master Halco Industries. Gate center latching shall be Frost Free Latch Assembly Type #17206.
5. Gate frame shall be designed for the width indicated and constructed so that the outer members shall not sag in excess of 1% of the gate leaf width or 2 inches, whichever is less.
6. Gate frame shall have 3/8" dia. adjustable truss rods on panels 5-ft. wide or wider.
7. Gate leafs shall have vertical bracing at maximum intervals of 8 ft. and shall have a horizontal interior member if the fabric height is 8 ft. or more. Additional horizontal, vertical or diagonal member or diagonal truss rods may be needed to comply with requirements of 2.01, C, 4 herein.
8. Provide gate stop and hold open device for each gate leaf.

3.00 EXECUTION

3.01 INSTALLATION:

- A. Fencing shall be installed in accordance with ASTM F-567.
- B. Fencing shall be in alignment with posts, plumb and all wire work taut. Care shall be taken to equalize the tension of each side of corner posts.
- C. All corner, pull, end and gate posts over 5' shall be braced. All hardware shall be thoroughly secured, properly adjusted and in good working condition at the completion of the project.
- D. Fence fabric shall be taut and clipped to line posts and top rails at 14" intervals, with the bottom selvage 2" above the ground. Fabric shall be attached to terminal posts by stretcher bars as specified.
- E. All posts shall be set in concrete footings having the top surface shaped to shed water. Line posts shall be spaced uniformly at not greater than 10-foot centers.

1. Fence Posts:

Diameter of concrete footings shall be four times the post O.D. but not less than 10" in diameter. Posts shall be set in concrete a minimum depth of 24" plus an additional 3" for each 1 foot of fence height over 4 feet.

2. Gate Posts:

Diameter of concrete footings for swing gates shall be four times the post O.D. but not less than 12" in diameter. Posts shall be set in concrete a minimum depth of 42" for each gate leaf up to 12 ft. wide.

- F. Tension wire shall be installed around entire perimeter at bottom of 2-inch mesh.

4.00 MEASUREMENT AND PAYMENT

4.01 GENERAL:

- A. See Section 01 22 00 – Measurement and Payment for General Requirements. See Section 01 01 00 – Special Requirements/Bid Items for possible modifications to Standard Bid Items.
- B. If no specific bid item is provided, measurement and payment shall be considered incidental and shall be included in the bid price for other items of work for the project.

4.02 BID ITEMS:

Special provisions, requirements, revisions to these Bid Items, and/or additional Bid Items, may be included in Section 01 01 00 (green pages) or on the Drawings or Details.

A. Chain Link Fence

1. Includes furnishing and installing all new fencing materials in conformance with these Specifications.
2. Payment shall be made on a unit price lineal foot (L.F.) or lump sum (L.S.) basis for new fencing installed.

B. Gate

1. Includes furnishing and installing a gate as specified.
2. Payment shall be made on a per each (EA) basis.

****END OF SECTION****

1.00 GENERAL

1.01 DESCRIPTION:

- A. The work included in this section consists of replacing and restoring all existing lawn and other landscaping damaged directly, or indirectly, by the Contractor's operations and includes seeding, topsoil, sod, shrubs, trees and other items as required by these Specifications or indicated on the Drawings. It also includes the installation of new materials, as indicated on the Drawings.
- B. Special provisions, requirements, and/or revisions to this Specification and/or Bid Item(s) may be included in Section 01 01 00 (green pages) and/or on the Drawings or Details.

1.02 QUALITY ASSURANCE:

- A. For actual installation of seeding, sod and other landscape work, utilize personnel who are thoroughly experienced with the materials and methods required. All material shall conform to federal, state and local laws.
- B. Trees, shrubs and perennials:

Provide all plants of the quantity, size, genus, species, and variety shown and scheduled for landscape work, and complying with requirements of ANSI Z60.a "American Standard for Nursery Stock." Provide healthy, vigorous plant stock, grown in recognized Inland Northwest nurseries, in accordance with good horticultural practice and free of apparent disease and defects. If the specified landscape material is not obtainable, submit early proof of non-availability, together with proposal for use of equivalent material, in a timely manner.

1.03 SUBMITTALS:

Submittals shall conform to Section 01 33 00 of the Specifications and shall include:

1. Seeding:

Copies of certificates of inspection which include variety, purity and germination. Test shall have been performed within six months.

2. Sod:

Copies of certification from grower certifying the grass species and location of field from which sod was cut.

3. Trees and Shrubs:

Copies of certification from nursery certifying common and botanical name.

1.04 JOB CONDITIONS:

Proceed with and complete restoration work as rapidly as portions of site become available, working within seasonal limitations for each kind of work required.

1.05 SPECIAL WARRANTY:

Warranty any sod, trees, and shrubs for a period of one year after date of Substantial Completion against defects, including death and unsatisfactory growth, except for defects resulting from neglect by Owner, abuse or damage by others, or unusual phenomena or incidents that are beyond Contractor's control. Remove and replace items found to be dead or in unhealthy condition during warranty period. Make replacements during growth season following end of warranty period. Replace items that are in doubtful condition at end of warranty period, unless, in opinion of Engineer, it is advisable to extend warranty period for a full growing season.

2.00 PRODUCTS

2.01 TOPSOIL:

Topsoil for restoration work shall be friable, free-draining sandy loam, or loamy sand free of rocks, roots, and deleterious materials. Topsoil shall be free of materials which are prohibitive to plant growth, such as excessive salinity, alkalinity, or concentration of lead or arsenic. Obtain topsoil from local sources or from areas having similar soil characteristics to that found at project site. Obtain topsoil only from naturally well-drained sites where topsoil occurs in depths of not less than 4"; do not obtain from bogs or marshes.

2.02 SEED:

A. Purity, inert material and germination shall be in accordance with state and federal laws. Seed mix as follows:

1. Lawn Seed Mix

Gnome Kentucky Bluegrass	32%
Newport Kentucky Bluegrass	33%
Affinity Perennial Ryegrass	18%
Evening Shade Perennial Ryegrass	17%

2. Cover Crop Seed Mix

Rueben Canada Bluegrass	34%
Annual Ryegrass	33%
Hard Fescue	33%

3. Pasture Grass Seed Mix

Orchard Grass	30%
Lawn Tall Fescue	30%
Intermediate Wheat Grass	25%
Smooth Broome Grass	10%
Alfalfa	5%

2.03 SOD:

Sod for placement of lawn shall be 100% Bluegrass, A-34, Aldelphi, Bonnie Blue, Fylking, or Merion. Submit certification of percentages and variety of seed involved to Engineer for approval. Sod is to be free of poa annua (annual bluegrass) and all pests and disease. It shall be no more than 30 months old. Sod

shall not be cut from field more than 24 hours prior to delivery to project site. All sod shall be one continuous cut from one field.

2.04 SHRUBS AND TREES:

- A. Plants shall be healthy, in vigorous growing condition, and be guaranteed true to size, name and variety. Nomenclature shall be listed in Standardized Plant Names, Second Edition, 1942.
- B. Size and quality shall be equal to existing plants or as shown on the Plans. Plants shall be No. 1 nursery grown, freshly dug, of normal growth and habit, and free from diseases and insects.

2.05 FERTILIZER:

Fertilizer shall be a standard commercial grade of the kind and quantity specified herein. All fertilizer shall be furnished in standard unopened containers with weight and manufacturer's analysis clearly marked.

1. <u>Lawn Fertilizer</u>	
Total Nitrogen	20%
Available Phosphoric Acid	20%
Water Soluble Potash	10%
2. <u>Cover Crop Fertilizer</u>	
Total Nitrogen	18%
Available Phosphoric Acid	10%
Water Soluble Potash	10%
Sulphur	7%
3. <u>Pasture Fertilizer</u>	
Total Nitrogen	16%
Available Phosphoric Acid	20%
Potassium	0%
Sulphur	14%

2.06 MULCH:

Mulch shall be wood cellulose fiber. Wood cellulose fiber mulch shall be specially processed wood fiber containing no growth or germination inhibiting factors and shall be dyed a suitable color to facilitate inspection of the placement of the material.

2.07 TACKIFIER:

Mulch shall include a tackifier. Tackifier shall be RMB, or approved equal.

2.08 SLOPE STABILIZATION BLANKET:

Slope stabilization blanket shall consist of a mat of curled wood excelsior of 80% six-inch, or longer, fiber length. The top side of the blanket shall be covered with a photodegradable extruded plastic mesh. Blanket shall be Curlex brand, as manufactured by American Excelsior Company, or equal.

2.09 PLANT MATERIALS:

Provide all plant of the quantity, size, genus, species, and variety shown and scheduled for landscape work and complying with requirements of ANSI Z60.a “American Standard for Nursery Stock.”

3.00 EXECUTION

3.01 GENERAL:

- A. All plant materials shall be installed in accordance with the grower’s recommendations and/or in accordance with locally acceptable best landscape practice, and as approved by the Engineer.
- B. All tools and equipment shall be the type specially designed for the work and be satisfactory to the Engineer. In no case shall sod be removed by the use of a mattock or other tool which will not meet requirements specified herein.

3.02 LAWN REMOVAL:

In areas where removal and replacement of existing lawn is feasible, the sod to be removed shall be laid out in squares or strips of such size as to provide easy handling and matching. The sod shall then be carefully cut along these lines to a depth of four (4) inches, taking care to keep all cuts straight and strips of the same width. After the sod has been cut vertically, it shall be removed to a uniform depth of approximately three (3) inches with an approved type of sod cutter. This operation shall be performed in such manner as to ensure uniform thickness of sod throughout the operation.

3.03 SOD STORAGE:

- A. As the sod scalping proceeds, the sod strips shall be placed in neat piles at convenient locations and from then on they shall be maintained in a continuously damp condition until the sod strips are replaced on the lawn. In no case shall the sod remain in piles longer than two (2) days before replacement on the lawn.
- B. New sod delivered to the site shall be installed the same day as delivered.

3.04 SOIL PREPARATION:

- A. Contractor is responsible for any adverse drainage conditions that may affect plant growth, unless he contacts the Engineer immediately, indicating any possible problems. Prior to placing topsoil, review existing soil conditions for any contaminants that may have been discarded by other trades and notify Engineer immediately if any contaminants are present.

B. Lawn Soil Preparation:

Subgrade depths for lawn areas shall be minus 4” to allow for topsoil per the Engineer’s approval. Some subgrade preparation may be required. Scarify all compacted subgrades to promote proper drainage for plant growth. Remove debris from areas. Float or drag subgrades to produce smooth uniform surfaces. Distribute excess soil evenly throughout areas to be planted.

C. Cover Crop Seeding Preparation:

Scarify soil surface to promote proper drainage. Remove debris from area. Flatten soil surface to produce a smooth surface.

3.05 TOPSOIL PLACEMENT:

For lawn areas to be sodded or seeded, place 4” of topsoil and rake surface to a smooth uniform finish and compact to 80% dry maximum density. Set finished grade of topsoil 1-1/4” below top of adjacent pavement or sidewalk for sod installation, level of adjacent pavement, or sidewalk for areas to be seeded.

3.06 SOD INSTALLATION:

- A. Damaged or deteriorated existing sod, which is deemed by the Engineer not acceptable for reuse, shall be disposed of by the Contractor. The Contractor shall replace the loss of existing sod with new sod.
- B. Install sod so that all joints are tight and smooth on a smooth, moist, and lightly compacted surface. Lay sod such that long edges are parallel to contours and perpendicular to slope. Alternate joints in running bond fashion. Roll sod. Final rolling process must provide uniform surface. Contractor shall adjust grade irregularities as required. Irregularities of 1” will be maximum acceptable tolerance.

3.07 SEEDING:

- A. Seeding shall not be done during windy weather or when the ground is frozen, saturated or otherwise untillable.
- B. The exact time for seeding will be determined by actual weather conditions. The normal satisfactory period shall be considered as being between May 1 and September 1.

1. Lawn Seeding:

- a. Fertilizer shall be applied at a rate of six (6) pounds per thousand (1,000) square feet.
- b. Lawn seed shall be seeded over all areas to be put into lawn at a rate of eight (8) pounds per thousand (1,000) square feet.
- c. After seeding, ground horticultural peat moss shall be spread 1/4-inch deep over all seeded areas.

2. Cover Crop Seeding:

- a. Seeding may be performed by hydro-seeding or blowing. Equipment must be capable of obtaining an even distribution of materials at the proper rates.
- b. Fertilizer shall be applied at a rate of two hundred fifty (250) pounds per acre.
- c. Grass seed shall be applied at a rate of sixty (60) pounds per acre.

- d. Mulch shall be applied at a rate of two thousand (2,000) pounds per acre.
- e. Tackifier shall be applied at a rate of forty (40) pounds per acre.

3.08 STABILIZATION BLANKET INSTALLATION:

Area shall be prepared, fertilized, and seeded prior to installation of blanket. Unless otherwise noted or indicated on the Drawings, slopes steeper than 3:1 that will be seeded shall be provided with slope stabilization blanket.

3.09 PLANTING:

- A. Use planting soil beneath and around cavity between plant ball or roots and pit sides. Tamp base firmly, place plant or tree, tamp soil in layers, thoroughly water each layer, and loosen and fold burlap away from top of ball into pit. Fill balance of cavity with planting soil. Soak and continuously maintain adequate moisture.
- B. Use approved root transplanting compounds and herbicides for bulbs and plants to prevent disease and assure best plant growth. If deciduous trees or shrubs are moved when in full leaf, spray with anti-desiccant at nursery before moving and spray again two weeks later.
- C. Prune, thin out, and shape shrubs in accordance with standard horticultural practice. Prune trees only to remove injured or dead branches, if any. Prune shrubs to retain natural character.
- D. Wrap trunks of trees 1-½ inches in caliper and larger. Start at ground and cover trunk to a height of first branching and securely attach.
- E. Support trees immediately after planting by staking and/or guying to maintain trees in plumb position.
- F. Apply mulch to a depth of 3 inches around the plant. Fertilize all plants at time of planting.
- G. Planting areas with decorative rock, or bark shall include a geotextile type weedmat.

3.10 MAINTENANCE:

Maintenance shall begin following installation of material and shall continue until final acceptance of project or approved conditional acceptance. Work includes protection, watering, weeding, cultivating, mowing, tightening and repairing of guys, removal of dead materials, resetting plants to proper grades or upright position, and other operations necessary to proper growth and survival of all plant materials. All erosion shall be corrected at Contractor's expense.

3.11 FINAL INSPECTION:

Final inspection for seeded areas will not be made until thirty (30) days following completion of all seeding, fertilizing, and mulching as specified. Damage caused by the Contractor to areas which have been seeded or sodded shall be repaired and/or replaced by the Contractor at his own expense.

4.00 MEASUREMENT AND PAYMENT

4.01 GENERAL:

- A. See Section 01 22 00 – Measurement and Payment for General Requirements. See Section 01 01 00 – Special Requirements/Bid Items for possible modifications to Standard Bid Items.
- B. If no specific bid item is provided, measurement and payment shall be considered incidental and shall be included in the bid price for other items of work for the project.
- C. No additional payment will be made for restoring surfaces damaged outside of the respective pay limits.

4.02 BID ITEMS:

Special provisions, requirements, revisions to these Bid Items, and/or additional Bid Items, may be included in Section 01 01 00 (green pages) or on the Drawings or Details.

A. Lawn Seeding

- 1. Includes subgrade preparations, topsoil placement, furnishing and installing all components and maintenance.
- 2. Payment shall be on a unit price square yard (SY) or lump sum (LS) basis.

B. Cover Crop Seeding or Pasture Grass Seeding

- 1. Includes soil preparation and the furnishing and installing of all cover crop or pasture seed components and maintenance.
- 2. Payment shall be on a unit price square yard (SY) or lump sum (LS) basis.

C. Slope Stabilization Blanket

- 1. Includes furnishing and placing the slope stabilization blanket.
- 2. Payment shall be on a unit price square yard (SY) or lump sum (LS) basis.

D. Sod

- 1. Includes subgrade preparation, top soil placement, furnishing and installing sod and maintenance.
- 2. Payment shall be on a unit price square yard (SY) or lineal foot (LF) or lump sum (LS) basis.

E. Shrubs and Trees

1. Includes furnishing and installing all shrubs, trees and plants necessary for replacement or as shown on the drawings.
2. Payment shall be on a lump sum (LS) basis.

****END OF SECTION****

1.00 GENERAL

1.01 DESCRIPTION OF WORK INCLUDED:

- A. The work described in this Section includes furnishing and installing all water mains, fittings, valves, services, service pipe, thrust restraint and any and all other labor, materials and equipment necessary for the proper completion of the system as shown on the plans and described in the specifications. All required system disinfection and testing is also included in this Section.
- B. Special provisions, requirements and/or revisions to this Specification and/or Bid Item(s) may be included in Section 01 01 00 (green pages) and/or on the Drawings or Details.

1.02 MATERIAL STORAGE AND HANDLING:

- A. The Contractor shall make his own arrangements for adequate area and access thereto for proper and safe storing and protection of all pipe materials and appurtenances prior to installation. All pipe shall be stored on a flat and reasonably level surface, with the full pipe length supported to prevent distortion of the pipe during storage. Pipe shall not be stacked in piles higher than 5 feet. Pipe and other materials shall be unloaded, handled, transported and stored using all possible means to protect the materials and in full conformance with the manufacturer's written instructions, which the Contractor shall have on site. During cold weather, extra care shall be taken in handling all materials.
- B. Submittals shall conform to Section 01 33 00 of the Specifications.

2.00 PRODUCTS

2.01 GENERAL:

All materials required for proper completion of the work shall be new, of the highest quality, in conformance with the applicable AWWA standard, of proper pressure rating for the Owner's system and for the specified test pressure, and subject to the approval of the Engineer.

2.02 WATER MAIN PIPE:

- A. Ductile iron pipe shall be cement mortar lined with push on, mechanical, restrained or non-restrained joints as shown on the Drawings, in accordance with AWWA C104, C111, and C151 of the size shown on the Drawings and/or in the Bid Items included in this Section. See below for restrained joint specifications. Pipe shall be of the wall thickness specified in AWWA C-151/A21.51 for minimum pressure class 350 psi for pipe size 12" and smaller, unless specified otherwise on the Drawings or elsewhere in these Contract Documents. For pipe sizes larger than 12", the wall thickness class and/or pressure class rating shall be as specified on the Drawings or elsewhere in these Contract Documents. All flanged pipe shall be of the thickness specified in AWWA C-115/A21.15.
- B. PVC pipe shall be AWWA C-900 Class 235 for pipe size 12" and smaller, unless specified otherwise on the Drawings or elsewhere in these Contract Documents. For pipe sizes larger than 12", the wall thickness class and/or pressure class rating shall be as specified in the Drawings or elsewhere in these Contract Documents. All pipe dimensions, pressure classes, and dimension ratios (DRs) shall be specified in AWWA C-900/Table 1.

- C. High density polyethylene pipe (HDPE) 2½" and larger shall be DR 9 (200 psi WPR), ductile iron pipe size (DIPS) or steel pipe size (IPS) as needed to coordinate with and connect to other pipe and fittings in this project. The pipe shall contain no recycled compounds except that generated in the manufacturer's own plan from resin of the same specification from the same raw material. All pipe shall be in full conformance with AWWA C906, have nominal burst values of three times the Working Pressure Rating (WPR) of the pipe, and be NSF approved for potable water use. Pipe shall be Driscoplex 5100, Plexco HDPE (PE4710) or approved equal.
- D. High density polyethylene pipe (HDPE) 2" and smaller shall be IPS DR 9 (200 psi WPR). The pipe shall contain no recycled compounds except that generated in the manufacturer's own plan from resin of the same specification from the same raw material. All pipe shall be in full conformance with AWWA C901, have nominal burst values of three times the Working Pressure Rating (WPR) of the pipe, and be NSF approved for potable water use. Pipe shall be Driscoplex 5100, Plexco HDPE (PE4710) or approved equal.
- E. The type(s) of pipe to be used in this project shall be as specified in Section 01 01 00 or on the Drawings or in the Bid Proposal pages. Unless indicated otherwise, only one pipe material shall be used on the project.

2.03 PIPE FITTINGS AND COUPLINGS:

- A. Water main pipe fittings shall be cement mortar lined cast or ductile iron of pressure rating in conformance with the specified pipe, and in conformance with AWWA C104, C110, C111 and C153. Fitting configuration, size and end type shall be as shown on the Drawings and as required for the pipe, valves, details and appurtenances, as specified herein. See below for restrained joint specifications.
- B. All couplings shall be ductile iron of the type and size required by the connecting pipe, material, or appurtenances and of pressure rating at least equivalent to the other materials. The location, size and type of all couplings shall be as shown on the Drawings, or as approved by the Engineer. Ductile iron for center rings, bodies and end rings shall meet ASTM A536. Gaskets shall be virgin SBR, compounded for water service and meeting ASTM D2000 3BA 715. Bolts and nuts shall be high strength, low alloy steel meeting AWWA C111. Straight couplings shall be Romac 501 or approved equal. Flanged coupling adapters shall be used above ground only and shall be Romac FCA 501, or series 2100 megaflange EBAA, IRON, Inc., or approved equal.
- C. All joints with accessories, including gaskets, shall have a minimum working pressure rating equivalent to the minimum working pressure rating of the pipe and shall be in accordance with AWWA C110, C111 and C115, including Appendices.
- D. Gaskets for flanged pipe and fittings shall be a minimum 1/8 inch thick, full-faced or ring, synthetic rubber, and meet the material requirements of ANSI A21.11. Special gaskets may be needed for pipeline pressures over 250 psi per AWWA C111 and C115 and manufacturer's recommendations. Contractor shall provide documentation of gasket pressure rating with submittals.
- E. Fittings for HDPE Pipe
 - 1. Butt Fusion Fittings shall be PE3408 HDPE and in full conformance with ASTM D3261. Molded and fabricated fittings shall have a pressure rating equal to the pipe unless otherwise specified in the plans. Fabricated fittings shall be manufactured using Data Loggers. Temperature, fusion

pressure, and a graphic representation of the fusion cycle shall be part of the quality control records. All fittings shall be in full conformance with AWWA C906 and have nominal burst values of three and one-half times the Working Pressure Rating of the fitting.

2. Electrofusion Fittings shall be PE3408 HDPE and in full conformance with ASTM F1055. Fittings shall have a pressure rating equal to the pipe unless otherwise specified on the plans. All electrofusion fittings shall be in full conformance with AWWA C906 and have nominal burst values of three and one-half times the Working Pressure Rating (WPR) of the fitting.
3. Flanged and Mechanical Joint Adapters shall be PE3408 HDPE and in full conformance with ASTM D3261. Fittings shall have a pressure rating equal to the pipe unless otherwise specified on the plans.

2.04 RESTRAINED JOINTS FOR PIPE, VALVES AND FITTINGS FOR DI PIPE:

- A. The type of thrust restraint used shall be as indicated in Section 01 01 00 and/or on the Drawings. If not indicated, restrained joint pipe, valves and fittings, or thrust blocks, at the Contractor's option, shall be used.
- B. All restraining type joints, glands, gaskets, couplings, clamps or other devices used with ductile iron (DI) pipe shall:
 1. Be specifically designed, tested, manufactured, FM approved, and UL listed for the specific type, material, size and class of pipe upon which it is proposed for use and for buried service;
 2. Have bodies (if applicable) made entirely of ductile iron;
 3. Have a minimum tested safety factor of 2.0 times rated pressure of both the device and the pipe for all tests, when tested on the specific pipe type, material, size and class upon which it is proposed for use.
 4. Shall be as manufactured by EBAA Iron, Inc., or approved equal.
 5. Thrust blocks shall be used at connections between an existing water main and new water main. Joint restraint is not allowed because thrust restraint of existing mains is unknown.

2.05 RESTRAINED JOINTS FOR PIPE, VALVES AND FITTINGS FOR PVC PIPE:

- A. The type of thrust restraint used shall be as indicated in Section 01 01 00 and/or on the Drawings. If not indicated, restrained joint pipe, valves and fittings or thrust blocks, at the Contractor's option, shall be used.
- B. All restraining devices other than thrust blocks used on PVC water main pipe shall meet the following requirements:
 1. Mechanical joint restraining devices shall be specifically designed, tested, manufactured, FM approved, UL listed and successfully UNI-B-13 tested for the specific type, material, size and class of pipe upon which it is proposed for use, and for buried service;

2. Push-on joint restraining devices shall be specifically designed, tested, manufactured, FM approved or UL listed or successfully UNI-B-13 tested for the specific type, material, size and class of pipe upon which it is proposed for use, and for buried service;
3. Shall have bodies and tie bolts (if applicable) made entirely of ductile iron;
4. Shall have a minimum tested safety factor of 2.0 times rated pressure of both the device and the pipe for all tests, when tested on the specific pipe type, material, size and class upon which it is proposed for use;
5. Shall be as manufactured by EBAA Iron, Inc., or approved equal.
6. Thrust blocks shall be used at the connection between an existing water main and new water main. Joint restraint is not allowed because thrust restraint of the existing main is unknown.

2.06 VALVES AND VALVE BOXES:

- A. All valves larger than 2" shall be butterfly valves or resilient seat gate valves in accordance with AWWA C504, and C509 or C515, respectively, as indicated on the Drawings, with 2" operating nut (for buried service) or handwheel opening counter clockwise. Butterfly valves shall be Class 150B, Pratt, M & H Dresser or approved equal. Resilient seat gate valves shall be American Darling, M & H Dresser, or approved equal.
- B. Except as shown on the Drawings or Detail Drawings, valve boxes for buried-service valves shall be cast iron two-piece, slide-type, adjustable boxes with cast iron drop type lids marked "Water".
- C. Inside diameter of the bottom portion of the box shall be at least 8"; minimum inside diameter of the upper portion of the box shall be 5-1/4". Only identical cast iron valve box extensions shall be utilized. Valve box complete extension shall range from 48" to 72".

2.07 FIRE HYDRANTS:

Fire hydrants shall conform to AWWA C502 with two 2-1/2" hose connections, one 4-1/2" pumper port and 5-1/2" valve opening. Operating nut shall conform to the Owner's standard.

2.08 WATER SERVICE INSTALLATION/REPAIR MATERIALS:

- A. All materials shall conform to AWWA C800. All service pipe shall be copper unless otherwise specified on the drawings or Section 01 01 00. Except at HDPE service pipe, all materials shall provide electrical conductivity.

1. Copper Service Pipe

Service pipe 1-1/2" in diameter, or less, shall be Type K soft drawn copper tubing, conforming to the applicable AWWA standard for copper water tube. Larger diameter service pipe shall be as shown or specified on the Plans or detail Drawings.

2. HDPE Service Pipe

Shall conform to paragraphs **2.02 D** and **2.03 E** of this Section 40 00 00b.

3. Service Saddles

Service saddles for ductile iron and steel pipe shall be ductile or malleable iron double strap saddles, Romac Style 202, or approved equal. Service saddles for PVC pipe shall be ductile iron with minimum 2" wide stainless steel strap. Service saddles for HDPE pipe shall be nylon saddle with stainless steel double strap and spring washers.

4. Corporation Stops

Corporation stops shall be high quality bronze water works fittings conforming to AWWA C800, with male iron pipe thread inlets and outlets suitable for the connecting service pipe material, Ford, Mueller or approved equal.

5. Curb Stops and Curb Boxes

Curb stops, if required, shall be high quality bronze water works fittings conforming to the applicable AWWA standard and with the end types shown on the Plans or Details. Standard adjustable, two-piece, cast iron curb boxes shall be properly installed on all curb stops unless shown otherwise on the Drawings. All curb stops and connecting pipe shall be installed using end types that will restrain the curb stop and prevent it from coming off the service pipe under pressure, if the service pipe on the customer side of the stop is not connected. Electrical conductivity shall be adequate for high amperage electrical pipe thawing.

6. Pack Joints

Pack joint couplings shall provide a water-tight seal on all types of service pipe, including existing service pipe materials, and shall provide both positive end restraint and positive and adequate electrical conductivity for high amperage electrical pipe thawing. They shall be Ford "Pack Joint Couplings" for pipe 1¼" in diameter and larger, or Mueller 110 compression couplings for pipe 1" in diameter and smaller, with the end types as required for the particular pipe diameter and material encountered.

2.09 UTILITY MARKING TAPE:

A. Detectable

Detectable marking tape shall be 5.0 mil overall thickness, with a 50 gauge aluminum foil core covered by polyethylene. Tape shall be color coded, impregnated with permanent message printing under a mylar layer. Color and message shall be appropriate for specific utility. Tape shall be THORTEC, or equal.

B. Non-Detectable

Non-detectable marking tape shall be 4.0 mil overall thickness polyethylene, color code impregnated, with permanent message printing. Color and message shall be appropriate for specific utility. Tape shall be SHIELDTEC, or equal.

2.10 PIPE LOCATING WIRE AND CLAMPS:

Pipe locating wire shall be #10 insulated THHN solid copper. Clamps for attaching the locating wire to water services shall be UL listed ground clamps commonly used for grounding wire to copper, or galvanized steel water service pipes. Clamps shall be of the appropriate size as required for the wire and service pipe in the field.

2.11 RIGID INSULATION:

Insulation shall be closed cell, extruded polystyrene foam with minimum compressive strength of 25 psi (ASTM D1621-73) and maximum water absorption of 0.3% (ASTM C272-73). Minimum insulation board thickness shall be 2", unless otherwise specified. Insulation shall be installed in locations as shown on the Drawings or where minimum cover cannot be achieved.

2.12 THRUST BLOCKS:

All concrete for thrust blocks shall be made from high-early strength concrete with 3" slump, using six (6) ½ sack mix (611 pounds per cubic yard). Minimum 28-day compressive strength shall be 3,000 psi. All steel used to restrain fittings or valves shall be hot dip galvanized after fabrication and bending and coated with bitumastic after installation.

2.13 POLYETHYLENE ENCASEMENT:

Polyethylene encasement for ductile iron pipe, fittings and appurtenances, where required, shall conform to the latest revision of AWWA C105.

2.14 DOMESTIC INTERIOR PLUMBING SYSTEMS

Domestic interior hot and cold water plumbing system 1 – ½ inch diameter or less, where shown on the Drawings may be crosslinked polyethylene (PEX) pipe. PEX piping and system shall conform with AWWA C904-06 and all sub-referenced standards in the AWWA including but not limited to ASTM F876, ASTM A877 CSA B137.5, NSF/ANSI 14, and NSF/ANSI 61. All pipe and fittings shall be rated for continuous working pressure of 100 psig at 180 degrees F. All fittings used with PEX pipe shall be of cold-expansion design and meet ASTM F877, ASTM F2080, and above referenced requirements.

2.15 OTHER MATERIALS:

All other materials not specifically described, but required for proper completion of the work, shall be new, of the highest quality, in conformance with the applicable AWWA standard, of proper pressure rating for the Owner's system, and subject to the approval of the Engineer.

3.00 EXECUTION

3.01 TRENCHING, BEDDING, AND BACKFILLING:

- A. All trenching, bedding, backfilling, and compaction for water pipelines and appurtenances shall be done in strict conformance to the requirements of Section 02221 of these Specifications.
- B. Pipelines 4" in diameter and larger shall be bedded as specified herein and as shown on the applicable Detail Drawing. Pipelines smaller than 4" in diameter (service pipe) shall be bedded as specified

herein, with a minimum of 4" of pipe zone bedding material underneath and a minimum of 6" to each side and over the top of the pipe, unless specified otherwise in Section 01 01 00, on the Drawings, or in the Details.

3.02 INSPECTION OF MATERIALS:

All pipe and appurtenances shall be inspected before installation for cracks, defects, and workability. All dirt, scale, and burrs shall be removed as required for proper installation.

3.03 PIPELINE INSTALLATION:

A. General

1. All pipe and appurtenances shall be installed in accordance with the manufacturer's published recommendations and the appropriate AWWA Standard, except as modified by these Specifications. The Contractor's on-site representative shall have, at all times, a copy of the manufacturer's installation booklet. A copy of the appropriate installation booklet shall also be provided by the Contractor for the Engineer.
2. All pipe shall be laid on the lines and grades shown on the Drawings. If no pipe grades are shown, all pipe shall be laid on a straight grade without localized high points. In no case shall any pipe have an earth cover less than 5.0 feet, unless shown otherwise on the Drawings, or as may be approved in the field by the Engineer.
3. Maximum allowable pipe or joint deflection shall be 80% of manufacturer's recommended maximum.
4. Unless specifically approved otherwise by the Engineer, pipe laid on slopes steeper than 15% shall be laid uphill, with the bells facing uphill.
5. All water pipelines and appurtenances, including new services, shall be pressure tested and disinfected in accordance with these Specifications.
6. The Contractor shall provide adequate thrust restraint for both the test pressures and for normal system operation.

B. Fittings

All fittings shall be installed on a compacted foundation of bedding material and restrained with restrained joints or thrust blocks as shown on the Drawings and Detail Drawings. A torque wrench shall be used for final tightening of all mechanical joint and flanged end fittings.

C. Restrained Joint Pipe and Fittings

1. The type of thrust restraint used shall be as indicated in Section 01 01 00 and/or on the Drawings. If not indicated, restrained joint pipe, valves and fittings or thrust blocks, at the Contractor's option, shall be used.
2. Restraining type joints, glands, gaskets, couplings, clamps or other devices shall be installed in strict conformance with the manufacturer's written instructions for the specific pipe and fitting on

which it is being installed. Such written instructions shall be in the possession of the installer(s) at all times.

3. All restraining type joints, glands, gaskets, couplings, clamps or other devices shall remain exposed for inspection after assembly prior to backfill whether or not a First Test (see Pipeline Testing) is conducted.
4. Pipe joint restraint shall be provided on all pipe connected to a restrained joint fitting or valve unless a thrust block is used. Unless specified otherwise on the Drawings, the minimum length of pipe with joint restraint shall be as shown on the following table, as adjusted for actual test pressure and pipe depth at time of testing. The length of pipe indicated in the following table shall apply for each pipe connected to the valve or fitting; for example a 40' table value shall mean a minimum 40 feet of restrained joint pipe in each direction from the valve or fitting, at 100 psi test pressure.

**MINIMUM LENGTH RESTRAINED JOINT PIPE AT FITTINGS⁽¹⁾ AND VALVES
PRESSURE 100 PSI⁽²⁾, MIN. COVER DEPTH 4.0'⁽³⁾**

PIPE DIA.	D.I. PIPE ⁽⁴⁾	PVC PIPE ⁽⁴⁾
4", 6"	15'	20'
8", 10"	20'	25'
12"	25'	30'

⁽¹⁾ *One-half of the lengths shown may be used for 22-1/2 degree and 11-1/4 degree elbows.*

⁽²⁾ *For other pressures (i.e., test pressures) multiply by ratio to 100 psi.*

⁽³⁾ *Assumes pipe bedding compacted to minimum 90%.*

⁽⁴⁾ *For dead ends use 150% of the table value for D.I. pipe and use 200% of the table value for PVC pipe.*

D. Valves

Install valves in vertical position on a compacted foundation; check workability before installation. Valves not bolted to a fitting flange shall be installed with thrust blocks and/or restrained joints as specified herein. Furnish and install a valve box for each buried valve.

E. Valve Boxes

1. Set valve boxes during backfilling to be plumb; cushion lower unit from valve body; set top elevation 1/4-inch low in roadways and 1" high in other areas.
2. Extra care shall be taken when installing the upper unit of the valve box to provide adequate foundation under the lip to avoid future settlement of box.

F. Thrust Blocks

Install concrete thrust blocks at all changes in direction and at all connections and branches from the main. Size and place the thrust blocks in accordance with the Detail Drawings and/or as may be shown on the Drawings. Protect concrete during curing period. For restrained joint pipe, valves and fittings, install thrust blocks only where shown on the Drawings; however, at the Contractor's option, temporary blocking for testing may be utilized.

G. Fire Hydrants (New, Reconnect or Replace)

1. Hydrants shall be installed in accordance with the Detail Drawings and/or as shown on the Drawings. Hydrants shall be installed in a plumb position, with the break flange just above the finished grade or finished curb grade. Pumper port shall face the street, unless directed otherwise by the Engineer.
2. Where re-connection of an existing hydrant from an existing main to a new main is required, the Contractor shall preserve and protect the existing hydrant. Hydrant pipe may or may not be replaced, as may be shown on the Drawings or as required by the Engineer in the field. Prior to installing the new main, the Contractor shall expose the existing hydrant pipe to determine connection and grade requirement.
3. Where an existing hydrant is to be replaced by a new one as shown on the Drawings or as directed by the Engineer in the field, the Contractor shall remove the old hydrant full depth, if the new hydrant is to be installed at the same position, or at least 6" below finished grade if the new hydrant is to be installed elsewhere. All pipe and hydrant components left below grade shall be abandoned as specified herein. All removed pipe and components shall be disposed of offsite, unless directed otherwise.

H. Polyethylene Pipe Installation.

1. Joints between plain end pipes and fittings shall be made by butt fusion, and joints between main and saddle branch fittings shall be made using saddle fusion procedures that are recommended by the pipe and fitting manufacturer. The Contractor shall ensure that the person making heat fusion joints have received training the manufacture's recommended procedure. The Contractor shall maintain records of trained personnel. External and internal beads shall not be removed.
2. Polyethylene pipe and fittings may be joined together or to other materials by means of: (a) flanged connections (flanged adapters and back-up rings), (b) mechanical couplings designed for joining Polyethylene pipe or for joining Polyethylene pipe to another material, or (c) electro-fusion. When jointing pipes and fittings the manufacturer's installation instructions shall be followed.
3. Installation shall be accordance with ASTM D2321, manufacturer's recommendations, and this specification.
4. Pipe shall be bedded and backfilled in accordance with Section 31 23 00.

I. Polyethylene Encasement

Polyethylene encasement for ductile iron pipe, fittings and appurtenances will not be required except where called out on the Drawings or in Section 01 01 00. Where required it shall be installed in accordance with AWWA C105, method A, B or C at the Contractor's option unless specified otherwise on the Drawings or in Section 01 01 00.

3.04 CONNECTIONS TO EXISTING PIPELINES:

- A. At the locations shown on the Drawings, connections shall be made to existing pipelines. The Contractor, in advance of pipe trenching operations, shall expose the existing pipeline and determine the connection and grade requirements. Elbows and short lengths of pipe shall be used where necessary to connect to existing mains. Where approved by the Engineer, the new pipe alignment may be adjusted to make the connection. Connection details to existing mains are based on information available on size, type and location of existing pipe. The Contractor shall excavate and expose existing pipe where new mains are to be connected, prior to starting work in the area, to confirm location, depth, type and size of existing items and to confirm fittings and couplings required. The Contractor shall have the proper materials on hand prior to interrupting service and shall organize and perform his work to minimize interruptions. Care should be taken to prevent contamination of existing mains and new pipe and fittings. Disinfect prior to assembly.

3.05 BLOWOFF ASSEMBLIES:

Blowoff assemblies shall be constructed according to Detail Drawing. Location of assembly and distance from main shall be as shown on the Plans, or as directed by the Engineer in the field.

3.06 AIR VACUUM RELIEF STATIONS:

Install manholes, piping, fittings and valve assemblies plumb and vertical according to the Detail Drawings and in the locations shown on the Plans.

3.07 UTILITY MARKING TAPE:

A. Detectable Marking Tape

Unless otherwise indicated on the Plans or in Section 01 01 00, or unless pipe locating wire is installed, detectable utility marking tape shall be installed in all non-metallic pipe installations. Tape shall be placed a minimum of 24" above the pipe, but not less than 12" below finished grade.

B. Non-Detectable Marking Tape

Except where detectable marking tape is installed, non-detectable tape shall be installed in all pipe installations where pipe is not installed in a street right-of-way, whether or not pipe locating wire is installed. Tape shall be placed a minimum of 24" above the pipe, but not less than 12" below finished grade.

3.08 PIPE LOCATING WIRE AND CLAMPS:

Pipe locating wire shall be installed in all non-metallic pipe installations, unless indicated otherwise in Section 01 01 00 and/or on the Drawings. Wire shall be installed directly above and within 3" of the pipe, with care to

prevent damage to the wire. The Contractor shall minimize the use of splices in the locating wire. Splices may be made where approved by the Engineer. Approved splices and anywhere the locating wire insulation is damaged shall be sealed and made waterproof by the Contractor using an approved material to prevent corrosion of exposed wire. Wire shall be attached to each service connection at the main with clamps, as specified, to provide continuity through service pipes or through service locating wire. Wire shall be brought up into all main line valve boxes to the ground surface, with 1" of extra wire. Where mains intersect, or where more than one valve is installed, all wires shall be brought up into all valve boxes using jumper wires. The use of wire nuts is acceptable only inside the upper portion of valve boxes where they are accessible from the surface. Wire shall be brought up outside the lower box and inside the upper valve box section. Install a spacer to prevent the wire from being pinched between the upper and lower box sections. The Contractor shall test and demonstrate the continuity of all locating wires after backfill and compaction.

3.09 RIGID INSULATION:

Rigid insulation shall be placed at the top of the pipe zone bedding, but no more than 12" over the water main or services whenever the minimum depth of cover cannot be achieved, as approved by the Engineer, or where required on the Drawings. The insulation shall be 2' wide and extend 5 additional feet along the length of pipe after minimum cover has been achieved, beyond the particular crossing, or as specified otherwise. Typical installation locations shall include, but not be limited to, creek, culvert, and ditch crossings.

3.10 ABANDONMENT OF EXISTING PIPE:

See General Requirements Section 01 10 00.

3.11 PIPELINE TESTING:

A. General

1. All piping and appurtenances shall be tested as specified herein. All pipeline tests shall be conducted after installation of service saddles and corporation stops, if any, and other appurtenances that are directly connected to or a part of the pipeline. Service pipe shall be tested with the mains, or separately, at the Contractor's option. Also at the Contractor's option, the testing, disinfection, and flushing of any portion of pipeline may be combined into one operation.
2. The Contractor shall notify the Engineer 24 hours in advance of testing operations. All testing shall be done in the presence of the Engineer.
3. All testing equipment, fittings and gauges shall be provided by the Contractor and shall be approved as satisfactory by the Engineer prior to testing. The Engineer may, at any time, require a calibration check of the test pressure gauge.
4. Before testing, at least 36 hours shall elapse after the last concrete thrust block has been cast with high-early-strength cement, and at least seven days shall elapse after the last concrete thrust block has been cast with standard cement, unless otherwise required by the Drawings or Specifications.
5. The Contractor shall provide adequate permanent thrust restraint prior to testing.

B. Pressure and Leakage Testing

1. General

All new piping and appurtenances shall be hydrostatically tested as follows. The following combined pressure and leakage test shall be conducted on each individual section or installed pipe between valves. Interior hot and cold PEX plumbing system may be tested as a whole. Special testing requirements for PEX systems are included herein. For all other water services, unless indicated otherwise on the Drawings or Section 01 01 00, the First test may be conducted or eliminated, at the Contractor's option.

i. First Test:

An initial pressure and leakage test shall be conducted as soon as possible after sufficient backfill has been placed to prevent the movement of the pipe. Backfill shall be placed in such a manner that all couplings, fittings, valves and connections, including service connections, are completely exposed for visual inspection. The Contractor shall provide adequate lateral and vertical restraint to all pipe, valves and fittings during all testing.

ii. Second Test:

A final pressure and leakage test shall be conducted after all backfilling has been completed and before placement of permanent surfacing or structures.

iii. Test Pressure:

Test pressure for all piping shall be 200 psi, unless otherwise indicated in Section 01 01 00 or on the Drawings. The Contractor shall configure his testing setup and procedures such that the pressure against all new and existing valves and fittings shall not exceed their allowable test pressure.

2. Procedure

a. Test Duration:

The total time for each combined pressure and leakage test for each section shall be a minimum of 2 hours.

b. Filling:

The pipeline shall be filled with water for a minimum of 24 hours. Each section of the pipeline shall be filled slowly with water and all air expelled by means of taps at points of highest elevation.

c. Pressurization:

The specified test pressure shall be applied to the pipe and shall be maintained for the specified time. If the test pressure exceeds the capacity of the valves isolating the section of pipeline being tested, the Contractor shall pressurize adjacent sections with sufficient pressure to reduce the differential pressure on the valves to within their rated capacity.

3. Visible Leakage

During the first test, all pipe, couplings, fittings, valves and hydrants shall be examined by the Engineer and Contractor. All cracked or defective elements shall be replaced. Any observed leakage, regardless of the amount, shall be corrected. The test shall be repeated as necessary until all visible leakage has been corrected. The amount of any leakage that cannot be located and repaired shall be accurately measured by the Contractor.

4. Allowable Leakage

- a. During the second test, the amount of water pumped into the lines to maintain the test pressure shall be accurately measured by the Contractor.
- b. The allowable leakage rate for the pipe tested shall be as specified in AWWA C600 or, if not covered by AWWA, then as recommended in the pipe manufacturer's installation guide. If the Contractor elects to eliminate the First Test, however, regardless of the length of pipe being tested, the allowable leakage shall not exceed that for 350 feet of pipe, unless indicated otherwise on the Drawings. If the test leakage rate in any pipe is greater than the allowable, or greater than the leakage measured during the first test, the leakage shall be located and repaired. The test shall be repeated until the leakage rate is less than the allowable.

5. Connections to Existing Piping

The joints that are necessary to connect a pipeline, fitting, or valve to an existing pipeline shall be subjected to a visible leakage test (all joints exposed), conducted at system pressure for at least two (2) hours. All visible leakage shall be corrected by the Contractor. The test shall be repeated as necessary until all visible leakage has been corrected. It is the Contractor's responsibility to ensure that all fittings and pipe are adequately restrained while exposed during testing.

C. PEX Plumbing System Pressure and Leakage Testing

i. Flush and Visual Check

Purge air from plumbing system, cap system and visually check system for leakage.

ii. Preliminary Pressure Test

Pressurize the system to the greater or 1.5 times the maximum operating pressure or 100 psig for 30 minutes

As the piping expands, restore pressure, first at 10 minutes into the test and again at 20 minutes

At the end of the 30-minute preliminary test, pressure shall not fall by more than 8 psig from the maximum and there shall be no leakage.

iii. Main Pressure Test

The test pressure shall be restored and continued as the main test for 2 hours.

The main test pressure shall not fall more than 3 psig after 2 hours.

There shall be no visible leakage.

3.12 PIPELINE DISINFECTION:

A. General

1. It is the Contractor's responsibility to provide adequate disinfection and bacteriological test sampling of all water lines and appurtenances in accordance with the Department of Health requirements. Bacteriological test samples shall be taken at least once for every 1,200 lineal feet of pipe, or less, according to local utility or regulatory standards. It is also the Contractor's responsibility to ensure that neither contaminated water, nor water with strong chlorine solution enters any mains in use.
2. A disinfection method other than that specified herein may be used by the Contractor, provided it meets with the requirements stated herein, as well as AWWA Standard C651, and is specifically approved by the Engineer.

B. Water Pipelines

1. Use hypochlorite tablet method, placing tablets in pipe during laying; maintain scrupulous cleanliness during pipe laying so that no trench water or foreign matter enters pipe.
2. Attach tablets of 5G hypochlorite to top of pipe with potable water grade Permatex No. 1 under tablet only; for each length of pipe, use sufficient tablets for a dose of 50 mg/L.
3. When the pipe installation has been completed, fill the main with water, keeping filling velocity less than 1-ft/sec.; allow water to remain in the pipe for at least 24 hours.
4. Pipe, fittings and couplings connecting to an existing main and which cannot be disinfected with a new main, shall be thoroughly swabbed and flushed with strong chlorine solution immediately prior to installation, as should the existing main where exposed.

C. Flushing

1. After completion of filling, testing, and disinfection, flush heavily chlorinated water from the line by draining at low points until line is completely empty; refill with water and continue to flush main until chlorine residual of less than 1 mg/L is obtained.
2. It is the Contractor's responsibility to provide for the adequate and safe disposal of water flushed from mains.

3.13 WATER SERVICE INTERRUPTION, TEMPORARY WATER SERVICE:

- A. Water service interruption shall be kept to a minimum. Contractor shall install and maintain temporary water mains and services, at his own expense, in order to provide near-continuous water service. All service interruptions shall be coordinated with the Owner.
- B. Material for temporary lines shall be WADOH approved and shall be thoroughly flushed and chlorinated prior to use. Material may be new or used.
- C. Contractor shall provide an individual temporary service for each house or business affected. If more than one service is affected, the temporary main shall be a minimum size of 2" diameter.

- D. The Contractor shall obtain prior approval of the use of a fire hydrant for temporary water service.
- E. Contractor shall use the proper wrench for the hydrant and shall be responsible for any damage that occurs to the hydrant.

4.00 MEASUREMENT AND PAYMENT

4.01 GENERAL:

- A. See Section 01 22 00 - Measurement and Payment for General Requirements. See Section 01 01 00 - Special Requirements/Bid Items for possible modifications to Standard Bid Items. If no specific Bid Item is provided, measurement and payment shall be considered incidental and shall be included in the bid price for other items of work for the project.
- B. Payment for installed items shall be 50% maximum prior to completion of all testing.

4.02 BID ITEMS:

- A. Special provisions, requirements, and revisions to these Bid Items and/or additional Bid Items may be included in Section 01 01 00 (green pages) or on the Drawings or Details.

B. Water Pipe

- 1. These Bid Items shall include furnishing, installing, testing and disinfection of the specified water pipe including trench excavation, placing and compacting (not furnishing) bedding, backfilling and compaction work as specified in Section 31 23 00, unless a separate Bid Item is provided for same. It shall include pavement removal and replacement or other surface restoration, unless a separate Bid Item is provided for same. It shall also include pipe locating tape or wire, if applicable, unless a separate Bid Item is provided. It shall include polyethylene encasement for ductile iron pipe where required, unless a separate Bid Item is provided. It shall not include pipe joint restraining devices that are included in the Bid Item for the applicable Water Pipe Connection Detail, Fitting or Valve.
- 2. Payment shall be per Lineal Foot (LF) and shall be based on actual length of pipe installed, tested and accepted, as measured along the pipe, but not including pipe fittings or Details for which separate Bid Items are provided. Measurement shall be to the nearest foot, as measured by the Engineer.

C. CI/DI Fittings

- 1. These Bid Items shall include furnishing and installing ductile or cast iron fittings which are not included in other Bid Items, of the size indicated. All work and appurtenances related to these items are included, such as restraining type devices or thrust blocks where applicable. It shall include polyethylene encasement for fittings where required, unless a separate Bid Item is provided. These Bid Items include fittings not specifically shown on a Water Pipe Connection Detail but which are required to connect the Detail to an existing main. It shall include pavement replacement or other surface restoration unless a separate Bid Item is provided for same.
- 2. Measurement and Payment shall be per Each (EA) fitting installed and tested.

D. Water Pipe Connection Details

These Bid Items shall include furnishing and installing all items required to complete the indicated Detail(s) as shown on the Drawings. All work and appurtenances related to these items are included, such as valves, valve boxes, fittings, all restraining devices for fittings and pipe, and/or thrust blocks, excavation, bedding, backfilling and compaction related to the installation of the detail, except elbows or other fittings not shown on the Drawings but required to connect a Detail to an existing main. It shall include polyethylene encasement for fittings and valves where required, unless a separate Bid Item is provided. It shall include pavement replacement or other surface restoration, unless a separate Bid Item is provided for same. It shall include pipe required to connect a Detail to an existing main, unless a separate Bid Item is provided for same. Payment shall be on a Lump Sum (LS) basis for each Detail.

E. Resilient Seat Gate Valves (RSGV)

1. This Bid Item shall include furnishing and installing resilient seat gate valves that are not included in other Bid Items, of the size indicated and as shown on the Drawings. All work and appurtenances related to these items are included, such as excavation, bedding, backfill, valve boxes, restrained type glands, or thrust blocks where applicable. It shall include polyethylene encasement for valves where required, unless a separate Bid Item is provided. It shall include pavement replacement or other surface restoration, unless a separate Bid Item is provided for same.
2. Measurement and payment shall be per each (EA) valve installed and tested.

F. Butterfly Valves (BFV)

1. This Bid Item shall include furnishing and installing butterfly valves that are not included in other Bid Items, of the size indicated and as shown on the Drawings. All work and appurtenances related to these items are included, such as excavation, bedding, backfill, valve boxes, restrained type glands, or thrust blocks where applicable. It shall include polyethylene encasement for valves where required, unless a separate Bid Item is provided. It shall include pavement replacement or other surface restoration, unless a separate Bid Item is provided for same.
2. Measurement and Payment shall be per each (EA) valve installed and tested.

G. Reconnect Fire Hydrant

1. This Bid Item shall include all materials and labor required to preserve and protect the existing fire hydrant (including its valve and pipe if applicable) where shown on the Plans and reconnecting to the new water main. It shall include furnishing and installing the tee, valve (if indicated), tie rods or other restraint and couplings (if necessary) required to complete the fully restrained reconnection to the new main, including all excavation, bedding, backfilling, compaction and related work. It shall include polyethylene encasement for valves and/or fittings where required, unless a separate Bid Item is provided. Restoration and/or pavement replacement shall be included, unless a separate Bid Item(s) is provided for same. Hydrant pipe (including excavation, bedding and backfill) is included in other Bid Item(s).

2. Measurement and payment shall be on a per each (EA) basis for the completed and tested fire hydrant reconnection.

H. New Fire Hydrant Assembly

This Bid Item shall include furnishing and installing a complete assembly as shown on the Detail Drawing and where indicated on the Plans or directed by the Engineer. It shall include furnishing and installing the main line tee, hydrant valve, hydrant, thrust block (if applicable), drain gravel, and all excavation, backfill and compaction for these items. It shall include polyethylene encasement for valves and/or fittings where required, unless a separate Bid Item is provided. Surface restoration(s) shall also be included, unless a separate Bid Item provides for same. Hydrant pipe (including excavation, bedding and backfill) is included in other Bid Item(s).

I. 3/4", 1", 1-1/2", or 2" Service Connection

These Bid Items shall include furnishing and installing saddles and corp stops, as specified herein, for new water service connections or reconnection of existing services to a new main as shown on the Plans or where directed by the Engineer. New service pipe, locating wire, and clamp are also included unless a separate Bid Item(s) is provided for same. In the case of reconnection of existing services to a new main, location and disconnection of the existing service and the installation of a coupling and service pipe is included, unless a separate Bid Item(s) is provided for same. Payment shall be per each (EA) completed connection.

J. 3/4", 1", 1-1/2", or 2" Service Pipe

1. These Bid Items shall include furnishing and installing the specified pipe, locating wire and clamps as required. Also included is excavation, placing and compacting (not furnishing) bedding, backfilling, and compaction work as specified in Section 31 23 00. Pavement or other surface replacement is included, unless a separate Bid Item(s) is included for same.
2. Payment shall be per Lineal Foot (LF) as measured to the nearest foot by the Engineer in the field.

K. 3/4", 1", 1-1/2", or 2" Curb Stop

These Bid Items shall include furnishing and installing the applicable size curb stop in accordance with the Detail Drawings and these Specifications including the curb box. Payment shall be per each (EA) completed installation.

L. Insulation for Service Pipe Installation

This Bid Item shall include all materials and labor required to provide and install the specified thickness of insulation board for water pipe or service where shown on the Drawings. Payment shall be per Lineal Foot (LF) of pipe insulation installed along the pipeline, regardless of pipe size.

****END OF SECTION****

1.00 GENERAL

1.01 DESCRIPTION OF WORK INCLUDED:

- A. The work described in this Section includes furnishing and installing all water meters, meter settings, boxes, vaults, and any and all other labor, materials and equipment necessary for the proper completion of the system as shown on the plans and described in the specifications.
- B. Special provisions, requirements and/or revisions to this Specification and/or Bid Item(s) may be included in Section 01 01 00 (green pages) and/or on the Drawings or Details.

1.02 1.02 QUALITY ASSURANCE:

- A. Meters shall be accepted only from those companies who are actively engaged in the manufacturing of their meters in the United States and who, in the sole judgment of the Owner, have demonstrated satisfactory operation, accuracy and durability. All meters shall be guaranteed against defects in materials and workmanship for a period of at least one (1) year from date of installation.
- B. All meters shall be as manufactured by Sensus or Neptune. Only one meter brand will be allowed for all size meters.
- C. Meters must meet AWWA new meter accuracy requirements. The meters will have an accuracy spread of plus or minus 1% over the normal operating range. All meters will perform to AWWA new meter accuracy standards for a period of 5 years or 500,000 gallons for 5/8", 750,000 gallons for 3/4", and 1,000,000 gallons for 1". The meters will continue to perform to at least AWWA repaired meter accuracy standards for an additional ten (10) years, following the new meter accuracy warranty.

1.03 SUBMITTALS:

Submittals shall conform to Section 01 33 00 of the specifications.

1.04 MATERIAL STORAGE AND HANDLING:

The Contractor shall make his own arrangements for adequate area and access thereto for proper and safe storing and protection of all materials and appurtenances prior to installation. During cold weather, extra care shall be taken in handling all materials.

2.00 PRODUCTS

2.01 GENERAL:

All materials required for proper completion of the work shall be new, of the highest quality, in conformance with the applicable AWWA standard, of proper pressure rating for the Owner's system and for the specified test pressure, and subject to the approval of the Engineer.

2.02 WATER METERS, 5/8" - 2":

- A. Meters shall be direct read and have threaded end connections unless otherwise noted. All meters shall conform to AWWA standard C-700 as most recently revised and shall be Magnetic Drive, Sealed Register, Positive Displacement Oscillating Piston or Nutating Disk Type Cold Water Meters. Meters shall be rated at a minimum of 150 psi working pressure.

- B. The entire meter exterior (except the CI frost bottom), including main case, register bonnet and lid shall be bronze. No external parts may be plastic. All meters shall have a non-corrosive water works bronze outer case with a separate measuring chamber which can be easily removed from the case. All meters shall have cast on them, in raised characters, the size, and direction of flow through the meter. Cast iron frost bottoms, or bronze bottoms shall be provided 5/8", 3/4" and 1". 1-1/2" and 2" meters shall be the split case type with bronze lower and upper shell assemblies. All maincases shall be guaranteed against defects in materials and workmanship for twenty-five (25) years from date of shipment. All external bolts and washers shall be of 300 series stainless steel. Full 3/4" meters shall have 7-1/2" laying length.
- C. The register shall be of the straight reading type and have a large test or sweep hand and a low flow (leak) indicator. **It shall read gallons.** All reduction gearing shall be contained in a permanently hermetically sealed, tamper-proof enclosure made from a corrosion resistant material and will be secured to the upper maincase by means of a locking device located in the interior of the meter so the register cannot be removed externally. The register shall be guaranteed for 25 years.
- D. The bronze register box and lid shall be secured to the maincase by means of a tamper resistant locking device. A locking screw requiring a special manufacturer-supplied tool, or factory installed seal wire, are the only security devices acceptable. Generator registers and remote registers shall be sealed by the Contractor after wiring. The measuring chamber shall be Water Works bronze or a suitable synthetic polymer and shall not be cast as part of the maincase. All assemblies shall be interchangeable in all measuring chamber assemblies of the same size.
- E. There shall be no stuffing box. The motion of the piston or disc will be transmitted to the sealed register through the use of a direct magnetic drive without any intermediate mechanical coupling. All meters must be provided with a corrosion resistant strainer which is easily removable from the meter without the meter itself being disconnected from the pipeline.
- F. Change gears will not be allowed to calibrate the meter. All registers of a particular registration and meter size shall be identical and completely interchangeable.

2.03 TURBINE WATER METERS, 2" - 6":

Meters shall be direct read with flanged connections unless otherwise noted. All meters shall comply with AWWA C-701 as well as all applicable requirements of Paragraph 2.01 of this Section. Strainers shall be of the same manufacturer as the meter, and intended for installation with the specific turbine meter to be installed.

2.04 GENERATOR REMOTE TYPE METERS AND REGISTERS:

Shall comply with AWWA C-706 for Direct-Reading Remote Registration Systems. The transmission wire for all meters shall be suitable and warranted for direct burial. After connection, the connection points at both registers shall be completely sealed in a silicon sealant as recommended by the manufacturer. After installation and testing, a tamper-resistant seal wire shall be attached to both registers. Meters shall be of the same manufacturer as all the meters in the project. The operation and accuracy of the generator register assembly shall be fully warranted as required in these specifications when operating in a wet or flooded pit location.

2.05 CONCRETE METER BOXES:

Shall be as manufactured by Brooks or Fogtite, or approved equal. Boxes for 5/8" x 3/4" and 3/4" meters shall be Brooks 37 Series, boxes for 1" meters shall be Brooks 38 series, boxes for 1-1/2" and 2" meters shall be Brooks

66 series (or the equivalent size Fogtite boxes). Concrete boxes shall be provided with cast iron lids, as well as approved traffic rated cast iron covers where applicable, and shall be as shown on the applicable Detail Drawings. Bases shall be open bottom.

2.06 RECTANGULAR PLASTIC METER BOXES:

- A. Shall be of structural foam construction utilizing HDPE (high density polyethylene) with ASTM D-638 tensile strength of 3,100 to 5,500 psi and ASTM D-790 flexural modulus 100,000 to 210,000 psi. Boxes shall next for shipment and shall provide for a positive interlock of all sections, an integral stainless steel or bronze locking nut molded into the top section. The Contractor shall furnish but not install a stainless steel or bronze penta-head locking bolt with each box. All boxes shall include a cast iron reading lid, hinged with stainless steel pins or nails. Boxes shall have a clear open area of approximately 12" x 20", minimum.
- B. Boxes shall be Carson 1220 series, or Ametek Jumbo 1320 series for 5/8" x 3/4" and 3/4" meter settings (non-traffic only), and shall be as shown on the applicable Detail Drawing.

2.07 COIL TYPE PVC (THERMOPLASTIC) METER BOXES:

Shall be Mueller/McCullough Thermal-Coil Meter Box as shown on the applicable Detail Drawing, 48" in depth, 15" inside diameter, with lockable CI lid, insulating pad and full 3/4" I.D. (net) polybutylene 250 psi tubing. They shall also be provided with ground clamps and wire as shown on the applicable Detail Drawing, integral lock angle inlet meter stop (also angle outlet stop on commercial and multi-family services), and 4" insulating pad. Boxes shall be fully pre-assembled and pre-tested at 175 psi prior to shipment, with a certification regarding no test leakage from the Mueller Company. Boxes shall be sized for 7-1/2" laying length 5/8" x 3/4" and 3/4" meters, with a setting depth of 20" to meter center line.

2.08 INSULATING BLANKET:

Insulating blankets for meter boxes shall be 5/8" thick cross-linked polyethylene closed-cell insulating material. The material shall be carefully cut to fit each size meter box for which it is intended and shall not be folded, damaged or creased. Each pad (one per box) shall be a single 1" minimum thickness, cut with rounded corners to prevent any opening around the inside edges or corners of the box. For concrete boxes the material shall be cut large enough to fit tightly to support itself.

2.09 COPPER SETTERS FOR 5/8" - 1" (METER BOX) INSTALLATIONS:

- A. Shall be of the size and dimensions as required for the applicable meter installation and in accordance with the applicable Detail Drawing, with pack joint end types. Minimum copper setter height shall be 24" from setter inlet centerline to meter inlet centerline.
- B. Copper setters on residential services shall be provided with integral lockwing inlet angle key valve. Copper setters on commercial (including multi-family) services shall be provided with both the specified inlet valve and an angle key outlet valve.
- C. All copper setters shall utilize lead-free solder, have integral saddle nuts and brace pipe eye. Copper setter and type shall provide an electrically conductive connection to copper pipe adequate to conduct high amperage due to service line electrical thawing practices. Copper setters shall be Ford or approved equal.

2.10 COPPER SETTERS FOR 5/8" - 1" (INTERIOR) INSTALLATIONS:

- A. Shall be specifically designed for indoor retro-fit installations, and shall be the specific setter type for each particular situation, such as verticals, corners, walls, drops, etc. Setters shall utilize lead-free solder, have integral saddle nuts and shall have end types as required, utilizing pack joints. A minimum 2 gage stranded copper wire and bronze ground clamps shall be provided with each setter to provide electrical ground should the meter be removed. All setters shall have both inlet and outlet key valves, with lock wing on inlet.
- B. Setters shall be as manufactured by Ford or approved equal. Setter size shall be the same as the existing service pipe and/or the required meter size.

2.11 METER SETTINGS FOR 1-1/2" - 3" METER INSTALLATIONS:

Unless otherwise shown on the drawings or details, these meter settings shall be individually and custom plumbed for each particular installation using galvanized steel pipe, nipples and fittings. All pipe, nipples and fittings shall be threaded, except the inlet meter valve and outlet fitting shall be thread x meter flange to match the flanged meter. Straight or angle inlet valves may be used as the situations warrant. The inlet valve shall be lockable. The outlet (customer) valve shall be a high quality bronze ball or gate valve with hand wheel, with threaded ends. Inside settings shall be grounded as above and shall be of the same size as existing plumbing and meter to be installed. Outside settings shall be of the same size as existing plumbing and meter to be installed and shall be as shown on the applicable Detail Drawing.

2.12 OTHER MATERIALS:

All other materials not specifically described but required for proper completion of the work shall be new, of the highest quality, in conformance with the applicable AWWA standard, and subject to the approval of the Engineer. See Section 40 00 00b for service pipe, curb stops, and pack joint specifications.

3.00 EXECUTION

3.01 TRENCHING, BEDDING, AND BACKFILLING:

All trenching, bedding, backfilling, and compaction for water meters and appurtenances shall be done in strict conformance to the requirements of Section 31 23 00 of these Specifications.

3.02 INSPECTION OF MATERIALS:

All meters and appurtenances shall be inspected before installation for cracks, defects and workability. All dirt, scale, and burrs shall be removed as required for proper installation.

3.03 METER BOX, CURB STOP, SETTER AND METER INSTALLATION:

- A. The Contractor shall be responsible for locating existing services.
- B. All meter boxes and setters shall be installed as shown on the applicable Detail Drawing. The compacted gravel base shall be leveled to insure that the meter box is set plumb and on a firm foundation. Excavation and gravel base shall be carefully measured to result in a finished installation with the box cover set 3/16" low in driving or sidewalk locations and flush with the surrounding finished grade in other locations. In no case shall the box be left in a depression, nor high enough to

cause a hazard. Covers shall be set such that the reading lid opening end (if applicable) faces the street.

- C. Meters shall not be installed in setters until the installation has been thoroughly flushed clean. The Contractor shall provide a short hose as required and flush the installation liberally from the City side to the inlet side of the setter. After installation of the meter, the Contractor shall open an outside hose faucet at the residence or business and flush liberally to pull as much of the service pipe debris as possible out of the customer's service line.
- D. The insulating pad shall be set to fit tightly in concrete boxes, and loosely (flat) on a stiffener ledge in plastic boxes, about 6" above the meter in both cases. No air gap (to the meter) at the edges or corners shall be evident when the pad is in place.

3.04 LARGE METER VAULT INSTALLATIONS:

- A. The meter vault, assembly, pipe, fittings and appurtenances shall be installed in accordance with the applicable Plans and Detail Drawings, and all applicable specifications.
- B. The Contractor's project schedule shall clearly indicate the approximate planned installation dates. At least 5 days notice shall be given the Owner and affected water customer prior to start of any work. The Contractor's schedule, timing, procedure and operation for each installation shall be approved by both the Owner and customer, and no service shut-off shall be made without 24 hour additional notice.
- C. Vaults shall be installed level, on a well-compacted gravel base.

3.05 INSIDE METER INSTALLATIONS:

- A. All inside meter installation locations and meter sizes shall be approved by the Owner prior to start of work. No service pipe, appurtenance, or building plumbing shall be replaced beyond the immediate limits of the meter setting, nor any changes made to the basic plumbing layout or direction(s) of flow of water, without specific written authorization of the Owner and building owner.
- B. All inside meter installations shall include a minimum 2 gage stranded copper wire and bronze ground clamps installed to provide an electrical ground around the meter in accordance with applicable electrical codes. All inside installations shall include a lockable key inlet meter valve and a bronze hand wheel customer valve, same size as original service pipe or meter setting.
- C. All meters and remote registers shall be installed so as to allow convenient visual reading of both registers. Remote register wire shall be installed neatly in as protected and concealed locations as possible, and stapled carefully at 24" intervals. Prior to acceptance, the generator and remote register shall be properly and accurately operating.

3.06 SERVICE LINE REPLACEMENT:

- A. The Contractor shall not replace any service line outside the limits of the meter box installation as shown on the applicable Detail Drawing unless specific authorization is provided by the Owner or Engineer. In cases where a deteriorated iron or steel service line will prevent the connection(s) from being made within these limits, the Engineer or Owner will authorize the Contractor to expose additional service line to the extent necessary to make the installation, if and as determined by the Engineer or Owner.

- B. In no case shall the Contractor proceed further into the private property without the express authorization of the Engineer or Owner and the owner of the affected property.
- C. All work performed under such field direction shall be paid as indicated for Service Pipe, and shall be subject to testing and inspection as specified herein.

3.07 TESTING:

- A. Testing shall be conducted under normal system operating pressure after all items, including the meter, have been installed. All fittings, joints, couplings and connections shall be exposed for visual inspection for leakage.
- B. Testing shall comply with all requirements of Section 40 00 00b.

3.08 DISINFECTION:

Disinfection shall comply with all requirements of Section 40 00 00b.

4.00 MEASUREMENT AND PAYMENT

4.01 GENERAL:

- A. See Section 01 22 00 - Measurement and Payment for General Requirements. See Section 01 01 00 - Special Requirements/Bid Items for possible modifications to Standard Bid Items.
- B. If no specific Bid Item is provided, measurement and payment shall be considered incidental and shall be included in the bid price for other items of work for the project.
- C. Payment for installed items shall be 50% maximum prior to completion of all testing.

4.02 BID ITEMS:

- A. Special provisions, requirements, revisions to these Bid Items, and/or additional Bid Items, may be included in Section 01 01 00 (green pages) or on the Drawings or Details.

1. 5/8" through 1" Meter and Meter Box:

These Bid Items shall include furnishing and installing all materials per the standard detail drawing provided including, but not limited to, meter, meter box, setter, pack joint and insulating blanket. Also included is excavation, furnishing gravel, backfilling and compacting. Pavement or other surface restoration is included unless a separate Bid Item(s) is included for same. Service pipe and curb stops are not included in this Bid Item. Payment shall be on a per each (EA) basis.

2. 1-1/2" and 2" Meter and Meter Box:

These Bid Items shall include furnishing and installing all materials per the standard detail drawing provided including, but not limited to, meter, meter box, valves and fittings, pack joint and insulating blanket. Also included is excavation, furnishing gravel, backfilling and compacting. Pavement or other surface restoration is included unless a separate Bid Item(s) is included for same. Service pipe and curb stops are not included in this Bid Item. Payment shall be on a per each (EA) basis.

3. 3" Meter and Meter Vault:

This Bid Item shall include furnishing and installing all materials per the standard detail drawing provided including, but not limited to, meter, strainer, couplings, meter vault, valves and fittings, and insulating blanket. Also included are excavation, furnishing gravel, backfilling and compacting. Pavement or other surface restoration is included unless a separate Bid Item(s) is included for same. Service pipe and curb stops are not included in this Bid Item. Payment shall be on a per each (EA) basis.

4. 5/8 through 1-1/2" Meter:

These Bid Items shall include furnishing and installing the specified size meter in an existing setter or yoke and shall include any required miscellaneous fittings. Payment shall be on a per each (EA) basis.

5. 3/4" Setter:

This bid item shall include furnishing and installing a 3/4" meter setter including labor and parts necessary to attach it to the existing or new service lines. Also included is removal of the existing meter box prior to setter installation and replacement of the existing meter box following setter installation. Payment shall be on a per each (EA) basis.

6. Concrete or Plastic Meter Box:

These Bid Items shall include furnishing and installing the specified meter box type to the depth shown in the applicable detail drawing. Payment shall be on a per each (EA) basis.

****END OF SECTION****

1.00 GENERAL

1.01 DESCRIPTION:

- A. The work included in this Section consists of furnishing and installing storm drains including storm drain pipe, manholes, catch basins and inlets, along with all appurtenances as shown on the Drawings and specified herein.
- B. Special provisions, requirements and/or revisions to this Specification and/or Bid Item(s) may be included in Section 01 01 00 (green pages) and/or on the Drawings or Details.

1.02 SUBMITTALS:

Submittals shall conform to Section 01 33 00 of these Specifications and shall include complete manufacturer's literature, drawings and installation instructions.

1.03 MATERIAL STORAGE AND HANDLING:

The Contractor shall make his own arrangements for adequate area and access thereto for proper and safe storing and protection of all pipe materials and appurtenances prior to installation. All pipe shall be stored on a flat and reasonably level surface, with the full pipe length supported to prevent distortion of the pipe during storage. Pipe shall not be stacked in piles higher than 5 feet. Pipe and other materials shall be unloaded, handled, transported and stored using all possible means to protect the materials, and in full conformance with the manufacturer's written instructions, which the Contractor shall have on site. During cold weather extra care shall be taken in handling all materials.

1.04 PROTECTION OF LIVE SEWERS:

All existing live storm sewers including inlets, catch basins and drywells shall remain in service at all times. Adequate provisions shall be made for collection and disposal of existing and potential storm sewer flow if any existing sewers are damaged. Any damage to the Owner's existing system shall be repaired with materials meeting these specifications at no cost to the owner, to a condition equal to or better than that which existed prior to the damage.

2.00 PRODUCTS

2.01 STORM DRAIN PIPE:

Storm drain pipe material and size shall be as noted on the Drawings and shall meet the following requirements:

A. PVC

Pipe shall be PVC conforming to ASTM D3034 for SDR 35. Joints shall conform to ASTM D3212 with restrained gaskets conforming to ASTM F477.

B. PWRIB

Pipe shall be PWRIB, as manufactured by PW Pipe of Eugene, Oregon. Pipe material shall be PVC conforming to ASTM D1784, Cell Class 12364B. Gasket materials shall conform to ASTM F477. Pipe construction shall conform to ASTM F794, AASHTO M304 and ASTM D3212.

C. Corrugated Polyethylene Pipe

Corrugated polyethylene pipe shall be high-density polyethylene corrugated pipe with smooth interior and watertight gasketed joints as manufactured by Advanced Drainage Systems (ADS), Blue Seal Water Tight as manufactured by Hancor, or equal. Corrugated polyethylene culvert pipe and storm sewer pipe shall conform to WSDOT/APWA Sections 7-02, 7-04 and 9-05, latest edition.

D. CMP

Both aluminum and steel storm sewer pipe shall conform to WSDOT/APWA Section 7-04, latest edition.

2.02 STORM DRAIN MANHOLES AND DRYWELLS:

- A. Refer to Section 03 40 00 and the Detail Drawings.
- B. Size shall be as indicated on the Drawings or Bid Sheet. Storm drain manholes shall be provided with metal frames and grate or with 24" dia. manhole ring and cover, as indicated on the Drawings.

2.03 CATCH BASINS AND INLETS:

- A. Catch basins shall conform to all requirements of WSDOT/APWA Type 1, Type 1L, Type 1P or Type 2, as indicated on the Drawings. (Standard Plan, WSDOT latest edition or as included in the Contract Documents). Size of Type 2 catch basins shall be as indicated on the Drawings or Bid Sheet and shall be provided with metal frames and grate or with 24" dia. manhole ring and cover, as indicated on the Drawings.
- B. Inlets shall conform to the requirements of WSDOT/APWA Standard Plan latest edition or as included in the Contract Documents.

2.04 METAL FRAMES AND GRATES:

Frames and grates for catch basins and inlets shall be per WSDOT/APWA Standards for solid metal cover, metal frame and vaned or other grate as indicated on the Drawings. (Standard Plan, WSDOT latest edition, or as included in the Contract Documents).

2.05 MANHOLE RING AND COVER:

Manhole ring and cover shall conform to WSDOT/APWA Type I standard, or other Type as indicated on the Drawings or Bid Sheet. Lettering shall be "STORM". (Standard Plan, WSDOT latest edition, or as included in the Contract Documents).

2.06 UTILITY MARKING TAPE:

Non-detectable marking tape shall be 4.0 mil overall thickness polyethylene, color code impregnated, with permanent message printing. Color and message shall be appropriate for specific utility. Tape shall be SHIELDTEC, or equal.

2.07 OTHER MATERIALS:

All other materials not specifically described in this Section, but required for a complete and operating installation, shall be new, first quality of their respective kinds as selected by the Contractor subject to the approval of the Engineer.

3.00 EXECUTION

3.01 INSPECTION OF MATERIALS:

All pipe, manholes, catch basins and appurtenances shall be inspected before installation for cracks, defects, and workability. All dirt, scale, and burrs shall be removed as required for proper installation. Defective materials shall not be installed and shall be immediately removed from the project.

3.02 TRENCHING, BEDDING, AND BACKFILLING:

All trenching, bedding, backfilling, and compaction for storm drains and appurtenances shall be done in strict conformance to the requirements of Section 31 23 00 of these Specifications.

3.03 PIPELINE INSTALLATION:

A. General

1. All pipe and appurtenances shall be installed in accordance with the manufacturer's published recommendations and any appropriate WSDOT/APWA Standards, except as modified by these Specifications. The Contractor's on-site representative shall at all times have a copy of the manufacturer's installation booklet. A copy of the appropriate installation booklet shall also be provided by the Contractor for the Engineer.
2. All pipe shall be laid on the lines and grades shown on the Drawings. Variance from established line and grade shall not be greater than 1/16th of an inch per inch diameter and not to exceed 0.1 ft, provided that such variation does not result in a level or reverse sloping invert.

3.04 UTILITY MARKING TAPE:

Unless otherwise indicated on the Plans or in Section 01 01 00, non-detectable utility marking tape shall be installed in all pipe installations where pipe is not installed in a street right-of-way. Tape shall be centered over the pipe and placed at 24" below the final surface grade.

3.05 STORM DRAIN MANHOLE, CATCH BASIN AND INLET INSTALLATION:

- A. Installation methods and materials shall comply with all requirements of Section 03 40 00.
- B. Storm drain manholes, catch basins and inlets including pipe connections shall be watertight.

3.06 STORM DRAIN PIPE TESTING:

- A. All storm drains shall be tested as specified herein after all backfilling has been completed and before placement of permanent surfacing. The Contractor shall notify the Engineer 24 hours in advance of testing operations. All testing shall be done in the presence of the Engineer.
- B. All testing equipment, plugs, fittings, and gauges shall be provided by the Contractor and shall be approved as satisfactory by the Engineer prior to testing. The Engineer may at any time require a calibration check of the test pressure gauge.
- C. If any pipeline fails to meet the requirements of the test method used, the Contractor shall determine at his expense the source of leakage and shall repair or replace all defective materials and/or workmanship at his expense. The complete pipe installation shall meet the requirements of the test method used before being considered acceptable.
- D. Storm drain cleaning and testing shall be in full conformance with the Cleaning and Testing requirements of Section 7-04, Storm Sewers, of the latest edition of the Standard Specifications for Road Bridge and Municipal Construction (WSDOT/APWA) except as modified herein.

3.07 STORM DRAIN INSPECTION:

All pipe and structures shall be thoroughly cleaned prior to requested final inspection. All storm drain lines shall be “lamped” between manholes by the Engineer. In addition to lamping, storm sewers pipelines are subject to television inspection by the Engineer. Any deficiencies shall be repaired by the Contractor. All subsequent inspections made by the Engineer to verify that deficiencies have been corrected shall be at the Contractor’s expense.

3.08 STORM DRAIN MANHOLE AND CATCH BASIN TESTING AND INSPECTION:

Acceptance testing and inspection shall be performed on all storm drain manholes and catch basins and shall comply with all requirements of Section 03 40 00.

3.09 CATCH BASIN GRADE ADJUSTMENT

Where indicated on the plans or directed by the Engineer in the field, the grate on an existing catch basin or manhole shall be adjusted either upward or downward as indicated or directed. Upward adjustments of 4” or more shall be made using pre-cast concrete risers or grade rings. Upward adjustments of less than 4” shall be made using either pre-cast concrete risers or grade rings or concrete pavers. Downward adjustments shall be made by removing or replacing existing risers, rings or pavers.

4.00 MEASUREMENT AND PAYMENT

4.01 GENERAL:

- A. See Section 01 22 00 – Measurement and Payment for General Requirements. See Section 01 01 00 – Special Requirements/Bid Items for possible modifications to Standard Bid Items.
- B. If no specific bid item is provided, measurement and payment shall be considered incidental and shall be included in the bid price for other items of work for the project.

C. Payment for installed items shall be 50% maximum prior to completion of all testing.

4.02 BID ITEMS:

Special provisions, requirements, revisions to these Bid Items, and/or additional Bid Items, may be included in Section 01 01 00 (green pages) or on the Drawings or Details.

A. Storm Drain Pipe

1. Diameters and materials are listed in the Bid Form.
2. The Bid Item(s) shall include furnishing and installing all pipe, fittings and appurtenances. They shall also include the trench excavation, removal of excess materials, placing and compacting (not furnishing) bedding material, backfilling, and compacting as specified in Section 31 23 00 unless a separate bid item is provided for same. They shall include testing as specified in this Section. They shall include pavement, concrete, or lawn removal and replacement or other surface restoration unless a separate bid item is provided for same. They shall also include pipe locating tape or wire if applicable, unless a separate bid item is provided. Payment shall be per Lineal Foot (LF) and shall be based on actual length of pipe installed, tested and accepted, as measured along the pipe, through fittings and between centers of manholes, catch basins or inlets. Measurement shall be to the nearest foot by the Engineer.

B. Storm Drain Manhole

1. Diameters and types are listed in the Bid Form. It includes all earthwork, furnishing and installing pre-cast sections, ring and cover or frame and grate (unless a separate Bid Item is provided for furnishing ring and cover or frame and grate), and pipe connections. Testing of manholes is included in this Bid Item.
2. Payment shall be made on a per each (EA) basis.

C. Catch Basin or Inlet

1. Diameters and types are listed on the Bid Form. It includes all earthwork, furnishing and installing pre-cast section, frame and grate (unless a separate Bid Item is provided for furnishing frame and grate) and pipe connections. Testing of catch basins is included in this Bid Item.
2. Payment shall be made on a per each (EA) basis.

D. Catch Basin or Inlet Grade Adjustment

1. This bid item shall be complete compensation for labor and materials including excavation, installation or removal of risers, grade rings or pavers, reinstallation of grate, backfill, compaction and surface restoration unless a separate bid item is provided on the bid schedule.
2. Payment shall be per each (EA) or per vertical foot (VF) for each catch basin or inlet for which a grade adjustment is required and completed. Payment for only one adjustment per catch basin or inlet will be made. Multiple payments for multiple adjustments to the same

catch basin or inlet will not be made. For payment per vertical foot, measurement shall be for the final grate elevation as compared to the existing grate grade. Adjustments made to a fraction of a foot will be rounded to the nearest half-foot.

****END OF SECTION****

1.00 GENERAL

1.01 DESCRIPTION OF WORK:

- A. The work included in this section consists of furnishing and installing pipe, fittings and related items, complete as specified herein and as indicated on the Drawings. Special pipe, fittings or installation requirements may be specified with the particular equipment involved.
- B. Not all the pipe and fittings listed in this section are necessarily used for this project.

1.02 RELATED WORK:

- A. Section 01 33 00 – Submittals Procedures
- B. Section 01 60 00 – Product Requirements
- C. Section - Amendments and Special Provisions to the WSDOT Standard Specifications
- D. Section 09 96 00 – High Performance Coatings
- E. Division 40 – Process Interconnections

1.03 REFERENCES:

- A. Standard Specifications for Road, Bridge, and Municipal Construction, Washington State Department of Transportation (WSDOT), Latest Edition.
- B. ASTM - American Society for Testing and Materials
 - 1. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - 2. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - 3. ASTM A182/A182M - Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
 - 4. ASTM A312/A312M - Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
 - 5. ASTM A351/A351M - Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.
 - 6. ASTM A403/A403M - Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings
 - 7. ASTM A743/A743M - Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application

8. ASTM A744/A744M - Standard Specification for Castings, Iron-Chromium-Nickel, Corrosion Resistant, for Severe Service
 9. ASTM A778 - Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products
 10. ASTM A865/A865M - Standard Specification for Threaded Couplings, Steel, Black or Zinc-Coated (Galvanized) Welded or Seamless, for Use in Steel Pipe Joints
 11. ASTM D1784 - Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
 12. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
 13. ASTM D2464 - Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
 14. ASTM D2467 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
 15. ASTM F439 – Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
 16. ASTM F441 - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80
 17. ASTM F1498 - Standard Specification for Taper Pipe Threads 60° for Thermoplastic Pipe and Fittings
- C. American Society of Mechanical Engineers
1. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard.
 2. ASME B1.20.1 - Pipe Threads, General Purpose, Inch.
 3. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
 4. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300.
 5. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard.
 6. ASME B16.9 - Factory-Made Wrought Buttwelding Fittings.
 7. ASME B16.11 - Forged Fittings, Socket-Welding and Threaded.
 8. ASME B16.12 - Cast Iron Threaded Drainage Fittings.
 9. ASME B16.20 - Metallic Gaskets for Pipe Flanges: Ring-Joint, Spiral-Wound, and Jacketed.

10. ASME B16.21 - Nonmetallic Flat Gaskets for Pipe Flanges.
 11. ASME B16.42 - Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300.
 12. ASME/ANSI B36.19M - Stainless Steel Pipe
- D. American Water Works Association:
1. AWWA C104/A21.4 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
 2. AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings.
 3. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 4. AWWA C150/A21.50 - Thickness Design of Ductile-Iron Pipe.
 5. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast.
 6. AWWA C153/A21.53 - Ductile-Iron Compact Fittings.
 7. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances
 8. AWWA C606 - Standard for Grooved and Shouldered Joints
- 1.04 SUBMITTALS:
- A. Furnish submittals in accordance with Section 01 33 00 - Submittal Procedures.
 - B. Product Data: Submit product data sheets for all items proposed for use.
 - C. Pipe Restraint: Calculations shall be submitted verifying adequate materials for buried pipe restraint and for exposed pipe support and lateral restraint including seismic forces.
 - D. Submit shop drawings of all piping:
 1. Exposed, submerged, interior, exterior, and buried process piping.
 2. Piping support systems for all exposed and submerged piping.
 3. And other systems as requested by the Engineer.
 4. Plan and section views clearly showing pipe, fittings, valves, pipe hangers and supports, and process equipment and related appurtenances.
 5. Drawings shall be prepared from field measurements, and shall be completely dimensioned and labeled.
 6. Layout drawings shall be reviewed and approved by the Engineer before the applicable portion of the work is performed.

1.05 BIDDING:

- A. The cost for piping shall be included in the bid item for each project area. Payment shall be for each piping system, installed and tested.

1.06 WARRANTY:

- A. Installation Contractor shall warrant the materials and installation to be free of defects in materials and workmanship for a period of one (1)-year from the Date of Substantial Completion and in accordance with the General Conditions.
- B. Manufacturer's Warranty: Contractor shall submit manufacturer's standard warranty for all products furnished.

2.00 PRODUCTS

2.01 GENERAL PIPING MATERIALS:

- A. General. All pipe and fittings shall be of the type and size indicated on the Drawings. All pipe of each type shall be of the same manufacturer.
- B. Drawings. The Drawings indicate the general arrangement and location of equipment, pipe, fixtures, etc. It is desired that the indicated positions be followed as closely as possible. The exact location of the various items is subject to building construction and the actual equipment furnished by the Contractor. The Contractor shall verify the location of all items to be furnished, installed or connected.
- C. Pipe shall be grooved piping system, flanged, mechanical joint or push-on joint as required or as specified. Unless otherwise shown on the Drawings or specified herein, the following shall apply:
 - 1. Mechanical joint or push-on joint pipe shall be used for all buried pipe, as approved by the Engineer.
 - 2. Mechanical joint with mechanical restraints shall be used for all buried ductile iron fittings.
 - 3. Regarding joint restraint, it is the intent of the Plans and Specifications to use "meg-a-lug" type mechanical restraints in lieu of thrust blocking, unless otherwise shown on the drawings, or as approved by the Engineer.
 - 4. All exposed piping shall be the grooved piping system.
 - 5. All exposed piping (not buried) shall be provided without bitumastic or other petroleum based coatings, and with zinc primer for field painting.
 - 6. All ductile iron, cast iron and mild steel process piping shall be cement mortar-lined according to AWWA specifications, unless otherwise specified. Fittings shall be lined in accordance with the piping system where installed.
 - 7. All hardware and fasteners which are in contact with water or sewage, or are in or above open channels or tanks containing water or sewage shall be stainless steel. Hardware and

fasteners which are not stainless steel are to be hot-dip galvanized in accordance with ASTM A123.

2.02 DUCTILE IRON PIPE AND FITTINGS:

- A. Ductile iron pipe shall conform to the provisions of ANSI A21.51/AWWA C 151.
- B. All pipe and fittings shall be cement-mortar lined and seal coated in accordance with AWWA C104/A21.4 or glass-lined. Internal and external coatings on fittings shall conform to the pipe system where they are installed.
- C. Ductile iron pipe thickness shall conform to provisions of ANSI/AWWA C150/A21.50. Thickness class for all pipe and fittings shall be as follows:

Use	Required Class
General Use, 12" Diameter and Smaller	52
General Use, Over 12" Diameter	50 or 51
Threaded Taps	52
Grooving, for Grooved Joints – all sizes	53
Threading, for Threaded Flanges	53
Glass-Lined Pipe	53

- A. Fittings shall be ductile or cast iron and shall conform to ANSI A21.10/AWWA C110. ANSI C153/A21.53 compact fittings are acceptable with the approval of the Engineer. Contractor shall submit locations and service of compact fitting use for approval by the Engineer with piping submittals. Where taps are shown on fittings, tapping bosses shall be provided.
- B. Ductile iron pipe shall be furnished with mechanical joints, flanged joints or push-on joints as specified and shall conform to ANSI A21.11/AWWA C111 and ANSI A21.15/AWWA C115, or grooved joints as below. Flanges shall conform to ANSI B16.1, Class 125 drilling.
- C. Grooved pipe shall conform to AWWA Standard C-606-87, or the coupling manufacturer's recommendations for rigid grooving dimensions. Flexible grooves shall be provided as necessary for settlement or expansion only where shown on the Drawings or as approved by the Engineer.
- D. Where restrained joints are required, provide locked-type mechanical retainer glands with mechanical joint fittings, "Megalug"-style or approved equal.
- E. All buried process pipe shall be ductile iron and shall conform to these specifications unless otherwise shown on the drawings or approved by the Engineer.

2.03 GLASS-LINED CAST- OR DUCTILE-IRON PIPE:

- A. Glass-lined cast- or ductile-iron pipe shall be thickness Class 52 minimum.
- B. Glass-lined cast- or ductile-iron pipe with grooved or threaded fittings shall be thickness Class 53 minimum.
- C. Thickness: 0.010" minimum ASTM D7091

- D. Density: 2.5 to 3.0 grams per cubic centimeter as measured by ASTM D-792
- E. Hardness: 5 on Moh's scale, minimum
- F. Thermal shock tolerance: 350 deg F without crazing, blistering or spalling.
- G. The lining shall be resistant to corrosion by an HCl solution adjusted to a pH of 3 at 125 deg F and a NaOH solution adjusted to a pH of 10 at 125 deg F. Demonstration of this shall be by a weight loss of not more than 3 milligrams per square inch when exposed for 30 minutes. There shall be negligible visible loss of surface gloss to the lining after immersing a cut production sample in an 8% by weight sulfuric acid solution at 148 deg F for a period of 10 minutes.
- H. Coating shall be fused by heating to form an integral molecular bond with the cast iron.
- I. Lining shall be Ferroclad or Permutit SG-14, Vitco SG-14 or equal.

2.04 WALL PIPE:

- A. Wall pipe may be integrally cast or fabricated iron or steel. Ductile iron wall pipe shall be fabricated out of AWWA thickness Class 53 cement-lined ductile iron pipe. Collars shall be factory-welded with 360 degree fillet welds on both sides of the seep ring/collar. Field-welding shall not be allowed. Collars and welding shall meet the minimum dimensions and loading on the table below, or as otherwise required to support a dead-end thrust due to 250 psi internal pressure. Pipe ends, joints, and flanges shall meet the applicable requirements specified herein.

Size (in.)	Minimum Collar Thickness (in.)	Minimum Collar Outside Diameter (in.)	Minimum Design Load (lbs.)
4	0.25	6.80	4,500
6	0.25	8.90	9,300
8	0.25	11.05	16,000
10	0.25	13.10	24,000
12	0.25	15.20	34,000
14	0.25	17.30	46,000
16	0.25	19.40	59,000
18	0.38	22.50	75,000
20	0.38	24.60	92,000
24	0.38	28.80	130,000
30	0.50	36.00	200,000

2.05 STAINLESS STEEL PIPE AND FITTINGS:

- A. Service, Type, and Schedule:
 - 1. Not used
 - 2. Instrument Air Service: Type 304L, Schedule 10 or 40
 - 3. Liquid Service: Type 316L, Schedule 10

B. Pipe:

1. 2&1/2" and smaller: ASTM A312/A312M
2. 3" and larger: ASTM A778, "as-welded" grade
3. All stainless steel pipe shall be the schedule specified, and minimum wall thickness shall be per ANSI B36.19.

C. Joints:

1. 2&1/2" and smaller: Threaded or grooved.
2. 3" and larger: Grooved unless flanged joint is required for connection to equipment or valves.
3. Grooved joints:
 - a. ASTM A351, A743 and A744
 - b. Furnished with EPDM or fluoroelastomer gaskets suitable for service temperature.
 - c. Rigid Coupling (1&1/2" – 12"): Victaulic Style 489
 - d. Flexible Coupling (8 – 18"): Victaulic Style 77S
4. Flanged Joints:
 - a. ASTM A182M and ASME B16.5
 - b. Slip-on or butt-welded type.

D. Fittings:

1. Stainless steel 2&1/2" and smaller: ASTM A351/A351M, A743/A743M and A744/A744M, and ASTM A312/A312M.
2. Stainless steel 3" and larger: ASTM A778 or ASTM A 403/A403M
3. Bends shall be smooth-flow.

E. All stainless steel pipes and fittings shall be pickled and passivated following manufacture.

F. All hardware shall be same stainless steel type as pipe.

G. Flexible and Expansion Couplings for Low Pressure Air Service:

1. Non-restrained flexible (Size 3" and larger): Victaulic Style 230S
2. Non-restrained flexible expansion (Size 3" and larger): Victaulic Style 231S

3. Restrained flexible (Size 3" and larger): Victaulic Style 232S
- H. At locations where stainless steel pipe passes over supports that allow for expansion and contraction, a Teflon pad shall be affixed to the pipe or the support to prevent pipe abrasion and wear.
- 2.06 **GALVANIZED STEEL PIPE AND FITTINGS:**
- A. Service and Schedule: Utility Water, Schedule 40
 - B. Material: ASTM A53 and ASTM A123.
 - C. Fittings and Joints:
 1. 2 ½" or smaller pipe: Threaded, ASTM A865, or grooved, AWWA C606
 2. 3" and larger: Grooved, AWWA C606, unless flanged joint is required for connection to equipment or valves. Flanges per ASME B16.5.
- 2.07 **PVC PIPE AND FITTINGS:**
- A. Service and Schedule: Process Drainage and Utility Water, Schedule 80
 - B. Material: ASTM D1784, Type I, Grade I, with min. Cell Classification of 12454
 - C. Dimensions: ASTM D1785
 - D. Fittings:
 1. Exposed, 3" and smaller: Threaded, ASTM D2464
 2. Buried, 3" and smaller: Socket weld type, ASTM D2467
 - E. Threaded joints shall be provided where connecting to unions, valves and where future disassembly may be required.
- 2.08 **CHLORINATED POLYVINYL CHLORIDE (CPVC) PIPE AND FITTINGS:**
- A. Service and Schedule: Tertiary Treatment Building Chemical Feed Piping, Schedule 80
 - B. Material: ASTM D1784, Type IV, Grade I, min. Cell Classification of 23447
 - C. Dimensions: ASTM F441
 - D. Fittings and Joints:
 1. Exposed, 3" and smaller: Threaded, ASTM F439, ASTM F1498
 2. Buried, 3" and smaller: Socket weld type, ASTM F439
 3. 4" and larger: Flanged with ASME B16.1, Class 125 drilling

4. O-rings: Viton (FKM)
5. Hardware: Type 316L SS hex head bolts

2.09 GASKETS:

- A. Gaskets for mechanical or push-on joints shall be rubber, conforming to ANSI A21.11/AWWA C111.
- B. Gaskets for flanged fittings shall be full-face neoprene rubber.
- C. Gasket material shall be suitable for use in sewage or potable waterlines.
- D. Gasket material for activated sludge aeration piping and sludge holding tank air piping shall be suitable for high temperature conditions (350° F).

2.10 COUPLINGS:

- A. Grooved Mechanical Joint Coupling. Grooved-end couplings shall be suitable for the pipe being joined. Depending on the piping requirements, the coupling shall either provide a rigid joint or controlled pipe movement (for deflection and/or thermal expansion). Pipe grooving shall be in accordance with the coupling manufacturer's specifications. Couplings shall be Victaulic System by Victaulic Company or approved equal.
- B. Flexible Pipe Couplings. Flexible couplings are required on all pipe less than 36" dia. wherever a pipeline penetrates a structure or, where shown on the Drawings. Two (2) flexible couplings shall be placed in all pipe runs where the piping exits a structure to buried condition, within 10 ft of the structure or as directed by the Engineer, or called out on the drawings. One of these two (2) couplings may be a mechanical joint. Couplings shall be of the gasketed sleeve-type with diameter to properly fit the pipe as manufactured by EBAA Iron Inc., Dresser, Romac, Smith-Blair, or approved equal. Couplings shall be assembled on the job in a manner to insure permanently tight joints under all reasonable conditions of expansion and contraction. Couplings shall be restrained using restrained flexible couplings (see below for RFC) unless otherwise indicated on the Drawings. Gasket and O-ring material shall be as recommended by manufacturer for intended service. Buried or submerged couplings shall be provided with Type 304 stainless steel bolts and nuts. Couplings shall have an fusion bonded epoxy coating finish.
- C. Restrained Flexible Couplings (RFC). EBAA Series 3800 or approved equal. Shall comply with the following:
 1. Pipe size and type: 4-inch to 12-inch diameter, ductile iron, steel, or PVC C900 or ASTM D2241 pipe.
 2. Couplings shall connect and prevent the separation of two plain ends of pipe. The restraint mechanism shall incorporate a plurality of individually actuating gripping surfaces to maximize restraint capability, and have torque limiting twist off nuts to insure proper actuating of the restraint.
 3. Minimum joint deflection shall be 5 degrees.

4. The restraint devices shall receive a minimum of two coats of liquid thermoset epoxy coating with heat cure to follow each coat. The coating shall be electrostatically applied and heat cured. The coating shall be a polyester based powder to provide corrosion, impact, and UV resistance.
 5. The coupling sleeve internal surfaces (wetted parts) shall be lined with a minimum of 15 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C213.
 6. Sealing gaskets shall be constructed of EPDM. The coating and gaskets shall meet ANSI/NSF-61.
 7. Exterior surfaces shall be coated with a minimum of 6 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C116/A21.16.
 8. Ductile Iron components shall meet or exceed the requirements of ASTM A536, and shall be tested in accordance with said standard.
 9. The restrained joining system shall meet the applicable requirements of AWWA C219, ANSI/AWWA C111/A21.11, and ASTM D2000.
 10. T-bolts and nuts: 304 stainless steel.
- D. Restrained Flanged Coupling Adapters (RFCA). EBAA Series 2100 or Romac RFCA 2100 or approved equal. Shall comply with the following:
1. Flanged adapters shall be made of ductile iron conforming to ASTM A536 and have flange bolt circles that are compatible with ANSI/AWWA C110/A21.10 (125 lb./Class 150 Bolt Pattern).
 2. Restraint for flange adapter shall consist of a plurality of individual actuated gripping wedges to maximize restraint capability. Torque limiting actuating screws shall be used to insure proper initial set of gripping wedges.
 3. The flange adapters shall be capable of deflection during assembly or permit lengths of pipe to be field cut to allow a minimum 0.6 inch gap between the end of the pipe and the mating flange without affecting the integrity of the seal. Minimum joint deflection shall be 5 degrees.
 4. All internal surfaces of the gasket ring (wetted parts) shall be lined with a minimum of 15 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C213.
 5. Sealing gaskets shall be constructed of EPDM. The coating and gaskets shall meet ANSI/NSF-61.
 6. Exterior surfaces of the gasket ring shall be coated with a minimum of 6 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C116/A21.16.

7. Restraint ring coated with two coats of liquid thermoset epoxy coating with heat cure to follow each coat. The coating shall be electrostatically applied and heat cured. The coating shall be a polyester based powder to provide corrosion, impact, and UV resistance.
 8. T-bolts and nuts: stainless steel.
- E. Dismantling Joints (DJ): Dresser Style 131 or Romac DJ400 or approved equal. Shall comply with the following:
1. Flange Spool: AWWA Class D Steel Ring Flange, compatible with ANSI Class 125 and 150 bolt circles.
 2. Pipe: STD Weight Class per ASTM A53.
 3. End Ring & Bodies: The end ring and body are made from ASTM A536 65-45-12 Ductile Iron.
 4. Gaskets: NBR Gaskets are made from rubber compounded for water and sewer service in accordance with ASTM D 2000 MBA810Z.
 5. Bolts & Nuts: 304 stainless steel.
 6. Tie-Rods: 304 stainless steel.
 7. Coatings: Fusion bonded epoxy.
 8. Pressure Rating: 175 psig.
- F. Coupling (Standard). Dresser Style 253 or Romac Style 501 or equal.
1. Ductile iron to ASTM A-536. Grade 65-45-12
 2. Bolts and Nuts: 304 stainless steel.
 3. Gaskets: ASTM D-395 method A & B, NBR
 4. Coating: Fusion-Bonded Epoxy.
 5. Pressure Rating: 200 PSI working pressure per AWWA C219, -20°F to 212°F. Testing per AWWA C-219 (ANSI A21.11).
- G. Screwed Joints. Screwed joints shall be made of clean-cut threads to standard lengths, so made up that joint leaves not more than three threads exposed. Apply approved pipe compound to male threads only.
- 2.11 EXPANSION JOINTS (FLEXIBLE CONNECTORS):
- A. Expansion joints shall be used on all pump suction and discharge connections and blower discharge connections whether or not they are shown or called out on the Drawings with the exception of submersible pump suction and discharge lines and vertical turbine pump suction lines.

- B. The expansion joint shall provide stress relief in the piping system, due to the thermal expansion and contraction, and mechanical movements and vibration.
- C. Expansion joints shall have flanges drilled to mate with ANSI 125 or 150 flanges as required by the equipment and piping layout.
- D. Unless otherwise required to meet the movement requirements of the installation, the expansion joint shall be single arch. The arch shall be shallow and spherically shaped.
- E. All hardware and retaining rings shall be stainless steel.
- F. For low-temperature, non-corrosive applications, the joint shall be constructed of layers of neoprene rubber, reinforced with nylon tire cord, and two independent full-face steel flanges. Steel flanges shall be stainless steel for a corrosion resistant finish. Maximum temperature rating for this service shall be 212 degrees F. and maximum working pressure shall be 225 PSI up to 12-inch pipe diameter and 100 PSI for 14-inch through 20-inch diameter pipe. Maximum vacuum rating shall be 26" Hg (12.7 PSI).
- G. For corrosive, chemical, and sludge piping (chemical or biological sludge), joints shall be PTFE teflon or teflon-lined and shall be suitable for temperatures up to 400 degrees F and maximum working pressure up to 140 PSI. Maximum vacuum rating shall be 26" Hg (12.7 PSI). Teflon shall cover the full face of the flanges. Stainless steel retaining rings shall be provided to protect the flanges.
- H. For high temperature and blower discharge piping, expansion joints shall be constructed of reinforced EPDM or other suitable material and shall have a maximum temperature rating of 300 degrees F. and maximum working pressure shall be 40 psig. Maximum vacuum rating shall be 15" Hg (7.4 PSI). Stainless steel retaining rings shall be provided to protect the flanges.

2.12 BURIED PIPE RESTRAINT:

- A. EBAA Iron Inc. "Meg-a-lug" type mechanical restraints shall be used for buried pipe restraint in lieu of thrust blocking, except where shown otherwise on the drawings or as approved by the Engineer.

2.13 BURIED PIPE INSULATION:

- A. Rigid Glass Fiber: Owens Corning Foamular 150 Series, rigid foam insulation, 2" thick (R-10.8) with an exterior finish of 0.016" thick stucco embossed aluminum laminated to the board.

3.00 EXECUTION

3.01 INSTALLATION:

- A. General. Pipe shall be installed in accordance with good trade practice and in strict accordance with the manufacturer's instructions. The methods employed in handling and placing of pipe, fittings and equipment shall be such as to insure that after installation and testing they are in good condition.

3.02 EXTERIOR BURIED PIPING INSTALLATION:

- A. Unless otherwise shown on the Drawings, provide a minimum of 4 feet and maximum of 8 feet earth cover over exterior buried piping systems and appurtenances conveying water, fluids, or solutions subject to freezing. Pipes with the top of pipe less than 4-feet below grade shall be provided with rigid insulation over the pipe.
- B. Enter and exit through structure walls, floors, and ceilings by using penetrations and seals as shown on the Drawings.
- C. When entering or leaving structures with buried piping less than 36" dia., install 2 flexible pipe couplings within 10 ft of the structure.
- D. When entering or leaving structures with pipe 36" and larger, install a joint within 2 feet of point where pipe enters or leaves structure and install second joint not more than 6 feet nor less than 4 feet from first joint.
- E. Install expansion devices as necessary to allow expansion and contraction movement.
- F. Laying Pipe in Trench
 - 1. Excavate and backfill trench in accordance with the requirements in Division 02 or Standard Specifications for Road, Bridge, and Municipal Construction..
 - 2. Clean each pipe length thoroughly and inspect for compliance to Specifications.
 - 3. Grade trench bottom and excavate for pipe bell and lay pipe on trench bottom.
 - 4. Install gasket or joint material according to manufacturer's directions after joints have been thoroughly cleaned and examined.
 - 5. Lay pipe in only suitable weather with good trench conditions. Never lay pipe in water except where approved by Engineer.
 - 6. Seal open end of line with watertight plug if pipe laying stopped.
 - 7. Remove water in trench before removal of plug.
 - 8. Lay piping at uniform slope between elevations shown.
- G. Lining Up Push-on Joint Piping
 - 1. Lay piping on route lines shown on Drawings.
 - 2. Deflect from straight alignments or grades by vertical or horizontal curves or offsets.
 - 3. Observe maximum deflection values stated in manufacturer's approved written literature.
 - 4. Provide special bends when specified or where required alignment exceeds allowable deflections stipulated.

5. Install shorter lengths of pipe in such length and number that angular deflection of any joint, as represented by specified maximum deflection, is not exceeded.

H. Anchorage

1. Provide restrained joints unless shown or specified otherwise to prevent movement of piping caused by forces in or on buried piping tees, wye branches, bends, valves and plugs unless otherwise shown and/or specified.
2. Restrain pipe joints on buried pipe with properly compacted backfill within the minimum distance from restrained fitting joints as submitted by the Contractor and approved by the Engineer. Additional restraint may be needed for testing and prior to adequately compacted backfilling.
3. Place concrete blocking, when called for and approved by the Engineer, as shown or specified so that it extends from fitting into solid undisturbed earth wall. Concrete blocks shall not cover pipe joints. Provide bearing area of concrete in accordance with drawing detail.
4. Restrain pipe joints within a minimum distance from unrestrained or fixed fittings, plugs or valves as shown in the table below. Lengths in table are based on a minimum 4-foot depth of bury for poorly graded gravels and sands, at test pressures of 100 PSI, assuming a minimum safety factor of 1.5, and are applicable to both PVC and ductile iron pipe. If installation conditions differ from these, additional length of restrained pipe may be required by the Engineer at no additional cost to the Owner. It is the Contractor's responsibility to determine the minimum length of restrained pipe either from the table below, by submitted calculations approved by the Engineer, or from a determination by the Engineer. The Contractor must show the minimum length of restrained pipe on the exterior piping shop drawing submittal.

Pipe Size (inches)	Length of Restrained Pipe (feet) Each Side of Bend or Valve		
	Fitting Angle		Dead End, Plug or Valve
	0° to 45°	46° to 90°	
4	4	9	32
6	5	12	46
8	7	16	60
10	8	20	71
12	9	22	78
14	11	25	88
16	12	28	98
18	13	31	110
20	15	34	121
24	17	40	138
30	20	47	149

Listed lengths are based on a test pressure of 100 psi. To compute the length for a different test pressure use the following equation:

Length = (Test Pressure/100) x (Table Value).”

- I. Install insulating components where dissimilar metals are joined together.
- J. Identify Pipe in accordance with Section 33 05 26 - Utility Identification.

3.03 INTERIOR AND EXTERIOR PIPING INSTALLATION:

- A. All pipe shall be secured in place by use of blocking, hangers, brackets, clamps or other approved methods, and the weight thereof shall be carried independently of equipment. Special hangers and supports shall be as shown on the Standard Drawing Details and as specified in Section 40 05 07 - Hangers and Supports for Piping and Equipment.
- B. Pipe stands shall be supported by Schedule 40 galvanized steel pipe of the diameter required for adequate support, or as shown on the drawings, whichever is more conservative. Pipe stands shall include either pre-manufactured or shop formed pipe cradles and base plates, hot dip galvanized after manufacture or fabrication. Fasteners or anchor bolts shall be 304 Stainless Steel. Pipe stands for submerged service shall be 316 stainless steel.
- C. Piping installed adjacent to structures, where trench depth does not reach undisturbed earth, shall be supported as shown on the Drawings, or as approved by the Engineer.
- D. All piping shall be properly supported by anchors, brackets or hangers. Supports shall be placed at a maximum spacing of 10 feet and at all other locations needed to facilitate take-down of pipe and equipment removal. Maximum horizontal pipe hanger and support spacing shall not exceed distances as herein specified, as shown on the drawings, or as shown on Table 3 of MSS SP-69. Anchors and brackets for submerged service shall be 304 or 316 stainless steel.
- E. In erecting the pipe, a sufficient number of flexible couplers, screwed unions or flexible grooved joints shall be used to allow any sections or run of pipe to be disconnected without taking down adjacent runs.
- F. Flexible couplings shall be installed where shown on the Drawings and at such other points as may be required for ease of installation or removal of the pipe, subject to approval of the Engineer. Flexible couplings shall be of the positive lock type where necessary to prevent separation of pipe due to internal pressures.

3.04 INSTALLATION AT CONCRETE WALLS AND FITTINGS:

- A. Whenever a pipeline of any material terminates at, or extends through, a structural wall or sump, the Contractor shall install, in advance of pouring of concrete, the fittings or special casting required for the particular installation.
- B. Ductile iron or steel pipe to be cast in water bearing walls, or more than two feet below grade, shall have seep rings/thrust collars as specified for wall pipe herein.

- C. In the event of unavailability of suitable wall fittings poured into the concrete wall, the wall penetration shall be by concrete hole-saw penetration of proper diameter to accommodate “Link-Seal” wall penetration seal. Use “Link-Seal” mechanical seals for the penetration. Grout water side of penetration with non-shrink grout following installation and testing for water tightness.

*** * * END OF SECTION * * ***

1.00 GENERAL

1.01 DESCRIPTION OF WORK

- A. Work covered by this section consists of furnishing all labor, materials, tools, and equipment required for testing all piping systems specified in this Division.
- B. All piping and plumbing systems installed as part of the work shall be tested during construction and prior to functional testing of related systems and equipment.

1.02 RELATED WORK

- A. Section 01 33 00 - Submittal Procedures
- B. Section 01 75 00 – Testing, Start-Up, and Training
- C. Section 40 05 00 – Process Piping
- D. ANSI/AWWA C600 "Installation of Ductile-Iron Water Mains and Their Appurtenances
- E. Standard Specifications for Road, Bridge, and Municipal Construction, Washington State Department of Transportation (WSDOT), Latest Edition

1.03 SUBMITTALS

- A. Submittals shall be submitted in accordance with Section 01 33 00 - Submittal Procedures.
- B. Testing Plan: Submit testing plan for all piping systems. Submit plan a minimum of five (5) working days prior to each test. The plan shall include:
 - 1. Piping systems and section(s) to be tested.
 - 2. Testing date(s).
 - 3. Test type.
 - 4. Calibration procedure for field testing equipment.
 - 5. Method of isolation.
 - 6. Calculation of maximum allowable leakage for piping section(s) to be tested.
- C. Testing Form: Submit testing form within twenty-four (24) hours of completed testing.

1.04 BIDDING

- A. All costs for power, water, labor and material (including chemicals) required for testing or retesting shall be borne by the Contractor and shall be included in the cost for each piping system.

2.00 PRODUCTS (NOT USED)

3.00 EXECUTION

3.01 TESTING

A. General:

1. Notify Engineer in writing five (5) working days in advance of each test.
2. The Contractor shall perform the tests in the presence of the Engineer and/or Engineer's Designated Project Representative, and all tests must be witnessed by the Engineer or Engineer's Designated Project Representative.
3. All work involved with testing process and plumbing piping shall be completed prior to backfilling of piping or other activities that would isolate and prevent piping from being inspected.
4. The Contractor shall take all necessary precautions to prevent any joints from drawing while the pipelines and their appurtenances are being tested, and any damage to the pipes and their appurtenances or to any other structures resulting from these tests shall be repaired by the Contractor at no expense to the Owner.
5. Defective items revealed by the testing shall be removed and replaced or otherwise corrected to the Engineer's satisfaction, and the system again subjected to the same test. The complete piping installation shall meet the requirements of the test method used before being considered acceptable.

B. Pressure Piping.

1. Piping which normally operates under full conditions at a hydrostatic pressure head higher than the crown of the pipe shall be considered pressure piping.
2. All pressure process and plumbing piping shall be hydrostatically pressure tested as specified herein.
3. Test pressure shall be minimum 100 psi for piping, unless otherwise specified herein or on the Drawings, or as otherwise directed by the Engineer.
4. The test shall be made by closing valves or providing removable caps or plugs and filling the pipeline with water.
5. Provisions shall be made for release of all air in the lines.
6. Lines may be filled with water sufficient time before testing to allow for absorption of water by pipe or joint material.
7. After all joints are apparently tight and there is no evidence of leakage, the test pressure must be maintained a minimum of one hour or sufficiently longer to permit the Engineer to make an inspection of the system.

8. During the test, pipe, fittings and joints shall be completely tight and the leakage shall not exceed the rate required for the Hydrostatic Pressure Test, Paragraph 7-09.3(23) Standard Specifications for Road, Bridge, and Municipal Construction, WSDOT, Latest Edition.
- C. Ductile Iron Piping.
1. Ductile iron piping shall be tested in accordance with ANSI/AWWA C600 "Installation of Ductile-Iron Water Mains and Their Appurtenances".
 2. Unless otherwise specified, ductile iron piping shall be hydrostatically tested at not less than 1.25 times the working pressure at the highest point along the test section and not less than 1.5 times the working pressure at the lowest point of testing.
- D. Gravity Piping
1. Piping which normally operates at a hydrostatic head no higher than the pipe crown, and cannot be isolated and subjected to higher pressure during operation, shall be considered gravity piping.
 2. Gravity process piping shall be pressure tested as specified herein.
 3. All open wyes, tees, and stubs shall be plugged with removable caps or plugs, and securely fastened to withstand the internal test pressure.
 4. Testing shall be in accordance with Paragraph 7-17.3(2)B Exfiltration Test of the Standard Specifications for Road, Bridge, and Municipal Construction, WSDOT, Latest Edition.
 5. If approved by the Engineer, testing may be in accordance with Paragraph 7-17.3(2)E and F Low Pressure Air Test for Sanitary Sewers of the Standard Specifications for Road, Bridge, and Municipal Construction, WSDOT, Latest Edition. This testing is not approved for plastic pipe, buried, or other non-exposed piping.
 6. Where the natural ground water head over the pipe is 2 feet or less above the crown of pipe at the upper end of the test section, an infiltration test shall be required in accordance with Paragraph 7-17.3(2)C Infiltration Test of the Standard Specifications for Road, Bridge, and Municipal Construction, WSDOT, Latest Edition.

*** END OF SECTION ***

FORM 40 05 01-1 PIPING AND PLUMBING TESTING FORM

Testing Date: _____

Piping System Tested: _____

Piping Sections/Locations Tested: _____

Piping Material: _____

Piping Diameter: _____

Testing Method: _____

Testing Pressure: _____

Testing Duration: _____

Testing Media: _____

Calibration Procedure for Field Testing Equipment: _____

Maximum Allowable Leakage: _____

Pass/Fail: _____

Comments: _____

Tested By: _____
(Signature) Contractor or Contractor's Representative

Date of Test: _____

Witnessed By: _____
(Signature) Engineer or Engineer's Representative

Date of Test: _____

1.00 GENERAL

1.01 DESCRIPTION OF WORK

- A. Work covered by this section consists of furnishing all labor and material required to install hangers and supports for piping and equipment as specified in this Division and others.

1.02 RELATED WORK

- A. Section 01 33 00 – Submittal Procedures
- B. Section 01 60 00 – Product Requirements
- C. Section 09 96 00 – High Performance Coatings
- D. Division 5 - Metals
- E. Division 40 – Process Interconnections

1.03 REFERENCES

- A. American Society of Mechanical Engineers (ASME):
 - 1. B31.1 - Power Piping (SI Edition).
 - 2. B31.3 - Chemical Plant and Petroleum Refinery Piping.
 - 3. B31.9 - Building Services Piping.
- B. ASTM International (ASTM):
 - 1. A36 - Standard Specification for Carbon Structural Steel.
 - 2. A47 - Standard Specification for Ferritic Malleable Iron Castings.
 - 3. A48 - Standard Specification for Gray Iron Castings.
 - 4. A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - 5. A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 6. A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 - 7. A387 - Standard Specification for Pressure Vessel Plates, Alloy Steel, Chromium-Molybdenum.

8. A515 - Standard Specification for Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service.
 9. A536 - Standard Specification for Ductile Iron Castings.
 10. A575 - Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades.
 11. A668 - Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use.
 12. A1011 - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
 13. B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
- C. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS) Standard Practices:
1. SP-58 Pipe Hangers and Supports - Materials, Design and Manufacture.
 2. SP-69 Pipe Hangers and Supports - Selection and Application.
 3. SP-77 Guidelines for Pipe Support Contractual Relationships.
 4. SP-90 Guidelines on Terminology for Pipe Hangers and Supports.
 5. SP-127 Bracing for Piping Systems Seismic-Wind-Dynamic Design, Selection, Application.
- 1.04 SUBMITTALS
- A. Submittals shall be submitted in accordance with Section 01 33 00 - Submittal Procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
1. Preparation instructions and recommendations.
 2. Load capacity and sizing schedules specific to Project.
 3. Installation methods.
- C. Certifications:
1. Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements. Certificates shall be furnished only as required by specific codes, upon request.
- D. Shop Drawings:
1. Bases, hangers and supports for all exposed piping systems.

2. Connections to equipment and structure.
 3. Structural assemblies.
- E. Structural calculations for exposed pipe supports verifying adequate support, lateral pipe restraint, and seismic anchorage and bracing. Calculations shall be stamped by a professional engineer in the State of Washington.
- F. Closeout Submittals:
- G. Warranty: Warranty documents.
- H. Operation and Maintenance Data: Operation and maintenance data for installed products in accordance with Section 01 33 00 – Submittal Procedures. Include methods for maintaining installed products, and precautions against cleaning materials and methods detrimental to finishes and performance.

1.05 BIDDING

- A. The cost for pipe supports shall be included in the bid items for each piping system or equipment item for which they are required.

1.06 QUALIFICATIONS

- A. Piping support systems shall be designed and Shop Drawings prepared and sealed by a Registered Professional Engineer in the state where the Work is to be installed.

1.07 DESIGN REQUIREMENTS

A. General:

1. Design, size, and locate piping support systems throughout facility, whether shown or not.
2. Piping Smaller than 30 Inches: Supports are shown only where specific types and locations are required; additional pipe supports and expansion joints may be required.
3. Meet requirements of MSS SP 58 and ASME B31.1.

B. Pipe Support Systems:

1. Design pipe support systems for gravity and thrust loads imposed by weight of pipes, internal pressures, and/or thermal expansion/contraction including insulation and weight of fluid in pipes.
2. Seismic loads in accordance with governing codes.
3. Wind loads in accordance with governing codes.

1.08 WARRANTY

- A. Installation Contractor shall warrant the materials and installation to be free of defects in materials and workmanship for a period of one (1)-year from the Date of Substantial Completion and in accordance with the General Conditions.
- B. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official.

2.00 PRODUCTS

2.01 MANUFACTURERS

- A. All pipe hangers and pipe supports shall conform to the latest edition of MSS-SP-58 and MSS-SP-69 published by the Manufacturers Standardization Society of the Valve and Fittings Industry, Inc., Vienna, Virginia 22180.
- B. Pipe hangers and supports shall be manufactured by competent and reputable companies experienced in the application of pipe hanger and support systems.
- C. Approved Manufacturers:
 - 1. Anvil International, 2 Holland Way, Exeter, New Hampshire 03833
 - 2. Elcen Metal Product Company, 11900 Park Lawn Drive, Suite 450, Rockville, Maryland 20852
 - 3. Engineer-approved equal.

2.02 MANUFACTURED UNITS - APPLICATION REQUIREMENTS

- A. Fabricate hangers, supports and sway braces to comply with building codes.
- B. Do not use installed hangers for rigging or erection purposes.
- C. Materials available by product type. Provide materials to comply with location and application requirements unless noted otherwise on drawings and schedules.
 - 1. Pipe rings - Malleable iron, carbon steel, stainless steel.
 - 2. Clevis - Carbon steel, stainless steel.
 - 3. Steel pipe clamps - Carbon steel, alloy, stainless steel.
 - 4. Socket clamps - Carbon steel.
 - 5. Beam clamps - Malleable/ductile iron, hardened steel, carbon steel, forged steel.
 - 6. Structural attachments - Carbon steel, malleable iron.
 - 7. Ceiling plates/ceiling flanges - Plastic, cast iron, malleable iron.

8. Concrete inserts and attachments – Malleable iron, carbon steel; stainless steel body, fiberglass bars, polypropylene disc (iron cross design).
 9. Rod attachments - Carbon steel, malleable iron, forged steel.
 10. Pipe supports - Carbon steel, cast iron (schedule 40).
 11. Pipe shields and saddles - Carbon steel, alloy steel, stainless steel.
 12. Pipe rolls - Cast iron, carbon steel.
 13. Guides - Carbon steel; slides, carbon steel with PTFE slide plates.
 14. Engineered hangers - Carbon steel, stainless steel, chrome molybdenum steel.
- D. Finishes: Provide finishes to comply with location and application requirements unless noted otherwise on drawings and schedules.
1. Electro-plating galvanizing process per ASTM B633.
 2. Hot Dipped galvanizing process per ASTM A153.
 3. Epoxy paint.
 4. Zinc-rich paint.
 5. Standard primer shall meet Fed Spec TT-P-636.
- E. Application Requirements: Use components for intended service conditions only. Comply with service requirements below unless noted otherwise on drawings and schedules.
1. Steel hangers in contact with copper piping shall be copper plated, copper painted or epoxy coated.
 2. Exterior utility and mechanical yard areas shall use supports that are hot dip galvanized.
 3. Submerged piping hangers, supports, fasters, inserts, and hardware shall be manufactured from 316 stainless steel.
 4. Piping hangers, supports, fasters, inserts, and hardware in chemical storage areas shall be manufactured from 316 stainless steel.
- 2.03 MSS-SP-69 TYPES NOTED FOR PRODUCTS THAT ARE IN COMPLIANCE
- A. Copper Tubing Hangers: Fig. Numbers.
1. CT65 Light Weight Adjustable Clevis.
 2. CT69 Adjustable Swivel Ring, MSS-SP-69 (Type 10).
 3. CT109 Split Tubing Ring (Ring Only), MSS-SP-69 (Type 11).

4. CT121 Copper Tubing Riser Clamp, MSS-SP-69 (Type 8).
 5. CT121C Copper Tubing Riser Clamp.
 6. CT128R Rod Threaded Ceiling Flange.
 7. CT138R Extension Split Tubing Clamp (Rod Threaded), MSS-SP-69 (Type 12).
 8. CT255 Copper Tubing Alignment Guide.
 9. 67F Copper Tube Felt Lined Hanger.
 10. 69F Adjustable Swivel Ring Felt Lined.
- B. CPVC Hangers
1. 185 One Hole Pipe Strap
 2. 186 Two Hole Pipe Strap
 3. 187 Two Hole 90 Degree Side Mount Strap
 4. 188 Two Hole Stand Off Strap
- C. Pipe Rings: Fig. Numbers.
1. 67 Pipe or Conduit Hanger, MSS-SP-69 (Type 5).
 2. 69 Adjustable Swivel Ring, Tapped per NFPA Standards, MSS-SP-69 (Type 10).
 3. 104 Adjustable Swivel Ring, Split Ring Type, MSS-SP-69 (Type 6).
 4. 108 Split Pipe Ring, MSS-SP-69 (Type 11).
 5. 138R Extension Split Pipe Clamp (Rod Threaded), MSS-SP-69 (Type 12).
- D. Clevis: Fig. Numbers.
1. 65 Light Duty Adjustable Clevis.
 2. 67 Pipe or Conduit Hanger, MSS-SP-69 (Type 5).
 3. 260 ISS (Insulation Saddle System) for support of insulated pipe operating between -40 degrees F to 200 degrees F. See section 2.3.P.11 for additional information.
 4. 260 Adjustable Clevis Hanger, MSS-SP-69 (Type 1).
 5. 300 Adjustable Clevis for Insulated Lines, MSS-SP-69 (Type 1).
 6. 590 Adjustable Clevis for Ductile or Cast Iron Pipe, MSS-SP-69 (Type 1).

E. Steel Pipe Clamps: Fig. Numbers.

1. 40 Riser Clamp - Standard, MSS-SP-69 (Type 42).
2. 100 Extended Pipe Clamp.
3. 103 Offset Pipe Clamp.
4. 212 Medium Pipe Clamp, MSS-SP-69 (Type 4).
5. 212FP Earthquake Bracing Clamp, MSS-SP-69 (Type 4).
6. 216 Heavy Pipe Clamp, MSS-SP-69 (Type 4).
7. 224 Alloy Steel Pipe Clamp, MSS-SP-69 (Type 2).
8. 246 Heavy Duty Alloy Steel Pipe Clamp, MSS-SP-69 (Type 2).
9. 261 Extension Pipe or Riser Clamp, MSS-SP-69 (Type 8).
10. 295 Double Bolt Pipe Clamp, MSS-SP-69 (Type 3).
11. 295A Alloy Double Bolt Pipe Clamp, MSS-SP-69 (Type 3).
12. 295H Heavy Duty Double Bolt Pipe Clamp, MSS-SP-69 (Type 3).

F. Steel Riser Clamps: Fig. Numbers.

1. 40 Riser Clamp - Standard, MSS-SP-69 (Type 42).
2. 261 Extension Pipe or Riser Clamp, MSS-SP-69 (Type 8).

G. Socket Clamps (AWWA/Ductile/Cast Iron Pipe Sizes Only): Fig. Numbers.

1. 594 Socket Clamp Washer.
2. 595 Socket Clamp for Ductile Iron or Cast Iron Pipe, MSS-SP-69 (Type 8).
3. 599 Socket Clamp Washer.
4. 600 Socket Clamp for Ductile Iron or Cast Iron Pipe, MSS-SP-69 (Type 8).

H. Beam Clamps: Fig. Numbers.

1. 14 Adjustable Side Beam Clamp, MSS-SP-69 (Type 27).
2. 86 C-Clamp with Set Screw & Lock Nut, MSS-SP-69 (Type 23).
3. 87 C-Clamp with Set Screw & Fig. 89 Retaining Clip, MSS-SP-69 (Type 23).
4. 88 C-Clamp with Set Screw Only, MSS-SP-69 (Type 23).

5. 89 Retaining Clip.
 6. 89X Retaining Clip.
 7. 92 Universal C-type Clamp (Standard Throat), MSS-SP-69 (Type 19 and 23).
 8. 93 Universal C-type Clamp (Wide Throat), MSS-SP-69 (Type 19 and 23).
 9. 94 Wide Throat Top Beam C-Clamp, MSS-SP-69 (Type 19).
 10. 95 C-Clamp with Locknut, MSS-SP-69 (Type 23).
 11. 133 Standard Duty Beam Clamp, MSS-SP-69 (Type 21).
 12. 134 Heavy Duty Beam Clamp, MSS-SP-69 (Type 21).
 13. 217 Adjustable Side Beam Clamp, MSS-SP-69 (Type 25).
 14. 218 Malleable Beam Clamp without Extension Piece, MSS-SP-69 (Type 30).
 15. 227 Top Beam Clamp, MSS-SP-69 (Type 25).
 16. 228 Universal Forged Steel (UFS) Beam Clamp, MSS-SP-69 (Type 28 and 29).
 17. 292 Beam Clamp Right Hand Thread with Weld less Eye Nut, MSS-SP-69 (Type 28 and 29).
 18. 292L Beam Clamp Left Hand Thread with Weld less Eye Nut, MSS-SP-69 (Type 28 and 29).
- I. Structural Attachments: Fig. Numbers.
1. 54 Two Hole Welding Beam Lug.
 2. 55 Structural Welding Lug (Short), MSS-SP-69 (Type 57).
 3. 55L Structural Welding Lug (Long), MSS-SP-69 (Type 57).
 4. 60 Steel Washer Plate.
 5. 66 Welded Beam Attachment, MSS-SP-69 (Type 22).
 6. 112 Brace Fitting Complete.
 7. 113 Brace Fitting (Pipe End Only).
- J. Ceiling Plates and Ceiling Flanges: Fig. Numbers.
1. 127 Plastic Ceiling Plate.
 2. 128 Pipe Threaded, Ceiling Flange.

3. 128R Rod Threaded, Ceiling Flange.
 4. 153 Pipe Hanger Flange.
 5. 395 Cast Iron Ceiling Plate.
- K. Brackets: Fig. Numbers.
1. 194 Light Welded Steel Bracket, MSS-SP-69 (Type 31).
 2. 195 Medium Welded Steel Bracket, MSS-SP-69 (Type 32).
 3. 199 Heavy Welded Steel Bracket, MSS-SP-69 (Type 33).
 4. 202 Iron Side Beam Bracket, MSS-SP-69 (Type 34).
 5. 206 Steel Side Beam Bracket, MSS-SP-69 (Type 34).
 6. 207 Threaded Steel Side Beam Bracket, MSS-SP-69 (Type 34).
 7. 189 Straight Eye Socket UL, ULC and FM.
 8. 190 Off-Set Eye Socket UL, ULC, FM
- L. Concrete Inserts and Attachments: Fig. Numbers.
1. 47 Concrete Single Lug Plate.
 2. 49 Concrete Clevis Plate.
 3. 52 Concrete Rod Attachment Plate.
 4. 152 Screw Concrete Insert.
 5. 281 Wedge Type Concrete Insert, MSS-SP-69 (Type 18).
 6. 282 Universal Concrete Insert, MSS-SP-69 (Type 18).
 7. 285 Light Weight Concrete Insert, MSS-SP-69 (Type 19).
 8. 286 Iron Cross Design, MSS-SP-69 (Type 18).
- M. Hanger Rod and Rod Attachments: Fig. Numbers.
1. 110R Socket, Rod Threaded, MSS-SP-69 (Type 16).
 2. 114 Turnbuckle Adjuster, MSS-SP-69 (Type 15).
 3. 135 Straight Rod Coupling (With Sight-Hole).
 4. 135E Straight Rod Coupling (Less Sight-Hole).

5. 135R Straight Rod Coupling (Reducing).
 6. 136 Straight Rod Coupling, MSS-SP-69 (Type 40).
 7. 136R Straight Rod Coupling (Reducing).
 8. 140 Machine Threaded Rod. Threaded both ends with right-hand threads.
 9. 142 Machine Threaded Coach Screw Rod. Plain finish.
 10. 146 Continuous Machine Threaded Rods.
 11. 148 Machine Threaded Rod with Eye End.
 12. 157 Extension piece.
 13. 230 Turnbuckle, MSS-SP-69 (Type 13).
 14. 233 Turnbuckle, MSS-SP-69 (Type 13).
 15. 248 Machine Threaded Rod with Eye End. Right-hand threads with un-welded eye.
 16. 248L Machine Threaded Rod with Eye End. Left-hand threads with un-welded eye.
 17. 248X Machine Threaded Rod with Linked Eye Ends. Un-welded eye.
 18. 253 Machine Threaded Rod. Threaded both ends with right-hand and left-hand threads.
 19. 278 Machine Threaded Rod with Eye End. Right-hand threads with welded eye.
 20. 278L Machine Threaded Rod with Eye End. Left-hand threads with welded eye.
 21. 278X Machine Threaded Rod with Linked Eye Ends. Welded eye.
 22. 290 Thread Weld less Eye Nut (Right Hand Threads), MSS-SP-69 (Type 17).
 23. 290L Thread Weld less Eye Nut (Left Hand Threads), MSS-SP-69 (Type 17).
 24. 299 Forged Steel Clevis, MSS-SP-69 (Type 14).
- N. U-Bolts and Straps: Fig. Numbers.
1. 120 Light Weight U-Bolt.
 2. 126 One-Hole Clamp.
 3. 137 Standard U-Bolts, MSS-SP-69 (Type 24).
 4. 137C Plastic Coated U-Bolts, MSS-SP-69 (Type 24).
 5. 137S Special U-Bolts (Non-Standard).

6. 243 Pipe Strap.
 7. 244 Pipe Strap.
 8. 262 Strap Short, MSS-SP-69 (Type 26).
 9. 291 Clevis Pin with Cotters.
- O. Pipe Supports: Fig. Numbers.
1. 62 Pipe Stanchion, Type A, B and C.
 2. 63 Pipe Stanchion, Type A, B and C.
 3. 191 Pipe Stanchion Saddle With U-Bolt, MSS-SP-69 (Type 37).
 4. 192 Adjustable Pipe Saddle Support, MSS-SP-69 (Type 38).
 5. 258 Pipe Saddle Support, MSS-SP-69 (Type 36).
 6. 259 Pipe Stanchion Saddle Support, MSS-SP-69 (Type 37).
 7. 264 Adjustable Pipe Saddle Support, MSS-SP-69 (Type 38).
 8. 265 Adjustable Pipe Saddle Support with U-Bolt, MSS-SP-69 (Type 38).
- P. Trapeze and Channel Support: Fig. Numbers.
1. 45 Channel Assembly.
 2. 46 Universal Trapeze Assembly.
 3. 50 Equal Leg Angle for Trapeze Assembly.
- Q. Pipe Shields and Saddles: Fig. Numbers.
1. 160 Pipe Covering Protection Saddle, MSS-SP-69 (Type 39A and 39B).
 2. 161 Pipe Covering Protection Saddle, MSS-SP-69 (Type 39A and 39B).
 3. 162 Pipe Covering Protection Saddle, MSS-SP-69 (Type 39A and 39B).
 4. 163 Pipe Covering Protection Saddle, MSS-SP-69 (Type 39A and 39B).
 5. 164 Pipe Covering Protection Saddle, MSS-SP-69 (Type 39A and 39B).
 6. 165 Pipe Covering Protection Saddle, MSS-SP-69 (Type 39A and 39B).
 7. 165A Pipe Covering Protection Saddle (Alloy), MSS-SP-69 (Type 39A and 39B).
 8. 166A Pipe Covering Protection Saddle (Alloy), MSS-SP-69 (Type 39A and 39B).

9. 167 Insulation Protection Shield, MSS-SP-69 (Type 40).
10. 168 Rib-Lok Shield, MSS-SP-69 (Type 40).
11. 260 (ISS) Insulation Saddle System, Clevis with High Impact Glass Reinforced Polypropylene Saddle.

R. Pipe Rolls: Fig. Numbers.

1. 171 Single Pipe Roll, MSS-SP-69 (Type 41).
2. 175 Roller Chair, MSS-SP-69 (Type 44).
3. 177 Adjustable Pipe Roll Support, MSS-SP-69 (Type 41).
4. 178 Spring Cushion Hanger, MSS-SP-69 (Type 49).
5. 181 Adjustable Steel Yoke Pipe Roll, MSS-SP-69 (Type 43).
6. 271 Complete Pipe Roll Stand, MSS-SP-69 (Type 44).
7. 274 Adjustable Pipe Roll Stand With Base Plate, MSS-SP-69 (Type 46).
8. 274P Adjustable Pipe Roll Stand, Base Plate Only.
9. 275 Adjustable Pipe Roll Stand Without Base Plate.
10. 277 Pipe Roll and Base Plate with Cast Iron Base Plate, MSS-SP-69 (Type 45).
11. 277S Pipe Roll and Base Plate with Steel Base Plate.

S. Guides and Slides: Fig. Numbers.

1. 212 Medium Pipe Clamp, use with slide assemblies.
2. 255 Pipe Alignment Guide, Single Clamp (MVT 4-8 in.)
3. 256 Pipe Alignment Guide, Double Clamp (MVT 6-10 in.)
4. 257 Pipe Slides Assembly, Structural Tee Slide Assembly, MSS-SP-69 (Type 35).
5. 257A Pipe Slides Assembly, Structural Tee.
6. 432 Special Clamp, use with slide assemblies.
7. 436 Pipe Slides Assembly, Fabricated Tee Slide Assembly, MSS-SP-69 (Type 35).
8. 436A Pipe Slides Assembly, Fabricated Tee.
9. 439 Structural "H" Slide Assembly, Complete, MSS-SP-69 (Type 35).

10. 439A "H" Section Only.

2.04 METAL FRAMING

A. Provide metal framing channel, fittings and hardware components as indicated or required for the structural support of piping systems and equipment.

1. Metal framing shall be Anvil Strut as manufactured by Anvil International.

2. Accessories: As indicated or required by application and location.

a. Strut mounted pipe support, Klo-Shure insulated couplings with strut clamp, size range of 3/8 inch through 4 inch copper tube with 3/8 inch through 1 inch thick insulation.

b. Strut mounted pipe clamps.

c. Strut mounted pipe rollers.

d. Strut mounted Cushion Clamps (steel pipe and copper tube).

B. Materials Available: Provide materials and finishes to comply with locations and applications requirements as noted on drawings or schedules.

1. Channels shall be produced from prime structural metals complying with the following specification as applicable:

a. Pre-Galvanized Steel - ASTM A653.

b. Plain Steel - ASTM A570.

1) Finish: Hot-dip galvanized.

2) Finish: Supr-Green powder coating.

3) Finish: PVC coated.

c. Aluminum (Type 6063-T6) - ASTM B221.

d. Stainless Steel (Type 304 and 316) - ASTM A240.

2.05 EQUIPMENT SUPPORTS

A. Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements of Division 5.

2.06 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

A. Provide templates to ensure accurate location of anchor bolts.

3.00 EXECUTION

3.01 GENERAL REQUIREMENTS

A. Contractor General Requirements:

1. Incorporate in construction pipe hangers and supports to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
2. Comply with maximum load ratings with consideration for allowable stresses prescribed by ASME B31.1 or MSS SP-58.
3. Provide supports, guides and anchors that do not transmit unacceptable heat and vibration to building structure.
4. The selection of pipe hangers and supports shall be based upon the overall design concept of the piping systems and any special requirements, which may be called for in the specifications. The support systems shall provide for, and control, the free or intended movement of the piping including its movement in relation to that of connected equipment. (Extracted from ANSI/MSS-SP69, 2003, Page 1, Section 4.2, with permission of the publisher, the Manufacturers Standardization Society.)
5. Provide for vertical adjustments after installation of supported material and during commissioning, where feasible, to ensure pipe is at design elevation and slope.

B. Selection of Hangers and Supports for Pipe Movement:

1. Select hangers and supports to perform under all conditions of operation, allowing free expansion and contraction, and to prevent excessive stresses being introduced into piping system and connected equipment.
2. Angularity of rod hanger resulting from horizontal movement of the piping system from cold to hot positions shall not to exceed 4 degrees from vertical.
3. Where horizontal pipe movement is greater than 1/2 inch offset pipe hanger and support so that rod hanger is vertical in hot position.
4. Where significant vertical movement of the pipe occurs at the hanger location, a resilient support must be used. Selection of resilient supports shall be based on permissible load variation and effects on adjacent equipment. Support selection for typical load variations are shown in Table 2 of MSS-SP-69. Load and movement calculations shall be made for the proper selection of spring hangers. Vertical movement and load transfer from riser expansion to horizontal runs shall be given consideration when applying spring hangers. Spring Cushion Hangers may be used where vertical movement does not exceed 1/4 inch, and where formal load and movement calculations are not required. Variable spring hangers shall be used for all other resilient support requirements. Constant Support Hangers shall be used on piping systems where the deviation in supporting force must be limited to 6 percent and which cannot be accommodated by a Variable Spring Hanger. (Extracted from ANSI/MSS-SP69, 2003, Page 7, Section 7.4 and 7.4.1 to 7.4.3, inclusive, with permission of the publisher, the Manufacturers Standardization Society.)

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- C. Hanger Spacing: (Extracted from ANSI/MSS-SP69, 2003, Page 8, Table 3, with permission of the publisher, the Manufacturers Standardization Society.) All piping shall be properly supported by anchors, brackets or hangers. Hangers shall be placed at a maximum spacing of 10 feet or as shown in Table 3 below (whichever is shorter), and at all other locations needed to facilitate take-down of pipe and equipment removal.

TABLE 3 – Maximum Horizontal Pipe Hanger and Support Spacing

Nominal Pipe or Tube Size	1		2		3		4		5	6	7	8	9	10						
	Std Wt Steel Pipe				Copper Tube										Fire Protection	Ductile Iron Pipe	Cast Iron Soil	Glass	Plastic	Fiberglass Reinforced
	Water Service		Vapor Service		Water Service		Vapor Service													
in. mm	ft.	m	ft.	m	ft.	m	ft.	m												
¼ (6)	–	–	–	–	5	1.5	5	1.5	Follow requirements of the National Fire Protection Association See Section 14.	20 ft. (6.1 m) max spacing; min of one (1) hanger per pipe section close to the joint behind the bell and at change of direction and branch connections. For pipe sizes six (6) inches (150 mm) and under, installed on ASME B31 projects, that are subjected to loadings other than weight of pipe and contents, the span should be limited to the maximum spacing for water service steel pipe.	10 ft. (3.0 m) max spacing; min of one (1) hanger per pipe section close to joint on the barrel also at change of direction and branch connections	8 ft. (2.4 m) max spacing; follow pipe manufacturer's recommendations See Section 17.	Follow pipe manufacturer's recommendations for material and service condition. See Section 18.	Follow pipe manufacturer's recommendations for material and service condition. See Section 19.						
⅜ (10)	7	2.1	8	2.4	5	1.5	6	1.8												
½ (15)	7	2.1	8	2.4	5	1.5	6	1.8												
¾ (20)	7	2.1	9	2.7	5	1.5	7	2.1												
1 (25)	7	2.1	9	2.7	6	1.8	8	2.4												
1¼ (32)	7	2.1	9	2.7	7	2.1	9	2.7												
1½ (40)	9	2.7	12	3.7	8	2.4	10	3.0												
2 (50)	10	3.0	13	4.0	8	2.4	11	3.4												
2½ (65)	11	3.4	14	4.3	9	2.7	13	4.0												
3 (80)	12	3.7	15	4.6	10	3.0	14	4.3												
3½ (90)	13	4.0	16	4.9	11	3.4	15	4.6												
4 (100)	14	4.3	17	5.2	12	3.7	16	4.9												
5 (125)	16	4.9	19	5.8	13	4.0	18	5.5												
6 (150)	17	5.2	21	6.4	14	4.3	20	6.1												
8 (200)	19	5.8	24	7.3	16	4.9	23	7.0												
10 (250)	22	6.7	26	7.9	18	5.5	25	7.6												
12 (300)	23	7.0	30	9.1	19	5.8	28	8.5												
14 (350)	25	7.6	32	9.8	–	–	–	–												
16 (400)	27	8.2	35	10.7	–	–	–	–												
18 (450)	28	8.5	37	11.3	–	–	–	–												
20 (500)	30	9.1	39	11.9	–	–	–	–												
24 (600)	32	9.8	42	12.8	–	–	–	–												
30 (750)	33	10.1	44	13.4	–	–	–	–												

Notes: (1) For spacing supports incorporating type 40 shields, see table 5.
 (2) Does not apply where span calculations are made or where there are concentrated loads between supports such as flanges, valves, specialties, etc. or changes in direction requiring additional supports.
 (3) Unbalanced forces of hydrostatic or hydrodynamic origin (thrust forces) unless restrained externally can result in pipe movement and separation of joints if the joints of the system are not of a restrained joint design. See Section 13.3.

D. Pipe Attachments for Insulated Lines:

- The connections to pipe attachments shall be outside the insulation so that movement of the line shall not cause damage to the insulation. Insulation protection shields shall be provided to protect the vapor barrier of the insulation on cold lines. Under no circumstances shall hangers, supports or guides be applied directly to horizontal pipe or tubing on vapor barrier lines. For cryogenic piping systems, shields incorporating rigid, high-density polyurethane foam inserts or other load bearing insulation should be used. The support should include means for maintaining vapor barrier integrity. Because of the temperature/compressive strength relationship of polyurethane foam, the recommended shield designs must be selected to accommodate loading conditions at both the installation and operating temperature. (Extracted from ANSI/MSS-SP69, 2003, Page 10, Section 10 and 10.1 to 10.3, inclusive, with permission of the publisher, the Manufacturers Standardization Society.)

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2. Deviation to the above is permissible when the Anvil Fig 260 ISS (Insulation Saddle System) is used when proper insulating techniques are employed including the use of mastic and caulk on all insulation edges, and final taping.
- E. Recommended Minimum Rod Diameters for Single Rigid Rod Hangers: (Extracted from ANSI/MSS-SP69, 2003, Page 9, Table 4, with permission of the publisher, the Manufacturers Standardization Society.)
1. (1) For calculated loads, rod diameters may be sized in accordance with MSS SP-58, Table 3 provided Table 1 and Section 73 of MSS SP-58 are satisfied.
 2. (2) Rods may be reduced one size for double rod hangers. Minimum rod diameter shall be 3/8 inch (M10).
 3. (3) Columns noted refer to Table 3.

TABLE 4 – Recommended Min. Rod Diameter for Single Rigid Rod Hangers⁽¹⁾⁽²⁾

Nominal Pipe or Tubing Size		Columns ⁽³⁾ 1, 2, 6, 7		Columns ⁽³⁾ 3, 4, 8, 9, 10	
		Nominal Rod Diameter		Nominal Rod Diameter	
<i>in.</i>	<i>mm</i>	<i>ft.</i>	<i>m</i>	<i>ft.</i>	<i>m</i>
1/4	(6)	–	–	3/8	M10
3/8	(10)	3/8	M10	3/8	M10
1/2	(15)	3/8	M10	3/8	M10
3/4	(20)	3/8	M10	3/8	M10
1	(25)	3/8	M10	3/8	M10
1 1/4	(32)	3/8	M10	3/8	M10
1 1/2	(40)	3/8	M10	3/8	M10
2	(50)	3/8	M10	3/8	M10
2 1/2	(65)	1/2	M12	1/2	M12
3	(80)	1/2	M12	1/2	M12
3 1/2	(90)	1/2	M12	1/2	M12
4	(100)	5/8	M16	1/2	M12
5	(125)	5/8	M16	1/2	M12
6	(150)	3/4	M20	5/8	M16
8	(200)	3/4	M20	3/4	M20
10	(250)	7/8	M20	3/4	M20
12	(300)	7/8	M20	3/4	M20
14	(350)	1	M24	–	–
16	(400)	1	M24	–	–
18	(450)	1	M24	–	–
20	(500)	1 1/4	M30	–	–
24	(600)	1 1/4	M30	–	–
30	(750)	1 1/4	M30	–	–

- F. Anchors Guides and Restraints:
1. Anchors, guides and restraints shall be located by the Engineer responsible for piping design. Should the need or the desirability of relocating, eliminating or adding anchors, guides or restraints arise; such changes shall be brought to the attention of the Engineer for consideration and approval.
 2. Anchors, guides and restraints shall be designed for imposed loadings as determined by the Engineer. For guided systems, in the absence of specified lateral loads, the guide

shall be designed for 20 percent of the dead weight load based on the spans listed in Table 3, with a design load of 50 lb (0.22 kN) as a minimum.

3. For pressure piping with joints not having a restraining design, other positive restraining means such as clamps, rods and/or thrust blocking shall be used to maintain the integrity of the joints.
4. The necessity for, and the location of, shock suppressors and seismic control devices shall be as determined by the Engineer responsible for piping design.
5. The location, type and number of corrective devices which may be necessary to control any unforeseen vibrations, as determined after the piping is in service, are not a part of this standard.
6. Refer to MSS SP-127 for the design, selection, and application of the bracing piping systems subject to seismic - wind - dynamic loading.
7. (Extracted from ANSI/MSS-SP69, 2003, Page 11, Section 13 and 13.1 to 10.6, inclusive, with permission of the publisher, the Manufacturers Standardization Society.)

3.02 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

3.03 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify General Contractor and Engineer/Architect of unsatisfactory preparation before proceeding.

3.04 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.05 HANGER SPACING

- A. Plumbing Piping: Most stringent requirements of Plumbing Code, or authority having jurisdiction.
- B. Fire Protection: Comply with applicable fire code.
- C. Gas and Fuel Oil Piping: Comply with pipe manufacturer's recommendations and applicable codes.

- D. Copper Piping: Comply with pipe manufacturer's recommendations and applicable codes.
- E. Flexible System Grooved Pipe: Minimum of one hanger required per the minimum recommended pipe length. Comply with groove manufacturer's recommended average hangers per pipe length.
- F. When practical locate supports immediately adjacent to any change of direction of pipe. Total length of pipe between supports less than three-fourths the full hanger span.
- G. In case of concentrated loads (such as valves) the supports shall be placed as close as possible.
- H. Supports and hanger spacing shall be placed at a maximum spacing of 10 feet or as listed in ANSI/MSS-SP69, 2003, Table 3, whichever is shorter, and at all other locations needed to facilitate take-down of pipe and equipment removal.

3.06 HANGER INSTALLATION

- A. Install in accordance with Manufacturer's instructions.
- B. Clamps on Riser Piping:
 - 1. Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
 - 2. Bolt tightening torques shall be to industry standards.
 - 3. Cast Iron Pipes: Install clamp below joint.
 - 4. Steel Pipes: Clamp is fitted preferably below coupling or welded pipe lug.
- C. Use approved constant support type hangers where:
 - 1. For critical high temperature where vertical movement of pipe work is 1/2 inch or more.
 - 2. Transfer of load to adjacent hangers or connected equipment is not permitted.
- D. Use variable support spring hangers where:
 - 1. Transfer of load to adjacent piping or to connected equipment is not critical.
 - 2. Variation in supporting effect does not exceed 25 percent of total load.
- E. Adjust hangers to equalize load.
- F. Support from Structural Members: Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.
- G. Field welding of supports should be done by qualified welders using qualified welding procedures.
- H. Proper care and ventilation should be given when welding galvanized components.

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- I. Fastening of supports to structure shall be in accordance with methods approved by the building manufacturer and the Engineer. Provisions shall be made to distribute pipe loads over the proper structural components of the building with approved fastening devices.
- J. The following pipe support equipment and practices will not be acceptable:
 - 1. Use of wire or perforated straps.
 - 2. Hanging from un-reinforced roof decks or any portion of structure not approved by the engineer.
 - 3. Hanging from grating or other removable walkways or structural components.
 - 4. Hanging from other piping.
 - 5. Hanging pipes from ceiling in areas where roof system is not designed specifically to support pipes (Tertiary treatment building).
- K. Equipment shall be so positioned and aligned, and piping so supported, that no strain shall be induced within the equipment during or subsequent to the installation of pipe work.
- L. In erecting the pipe, a sufficient number of flexible couplers, screwed unions or flexible grooved joints shall be used to allow any sections or run of pipe to be disconnected without taking down adjacent runs.
- M. Internal piping shall be laterally restrained according to the building code for the seismic zone applicable.

3.07 HORIZONTAL MOVEMENT

- A. Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.
- B. Where horizontal pipe movement is greater than 1/2 inch offset pipe hanger and support so that rod hanger is vertical in hot position.

3.08 CONCRETE INSERTS

- A. Provide inserts for placement in formwork before concrete is poured.
- B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Where concrete slabs form finished ceilings, provide inserts to be flush with slab surface.
- D. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inch.

3.09 PIPE FLOOR AND WALL SUPPORT INSTALLATION

- A. Provide floor stands, wall bracing, concrete piers, etc., for all lines running near the floors or near walls and which can be properly supported or suspended by the walls or floors.
- B. Pipelines near concrete or masonry walls may also be hung by hangers carried from wall brackets at a higher level than pipe. Hanging of any pipe from another is prohibited.
- C. Pipe supported on stands that is greater than 4'-0" above the floor level (CL) shall have hold-down straps or clamps.

3.10 FINAL ADJUSTMENT

A. Adjust Hangers and Supports:

- 1. Ensure that rod is vertical under operating conditions.
- 2. Equalize loads.

B. Adjustable Clevis:

- 1. Tighten hanger load nut securely to ensure proper hanger performance.
- 2. Tighten upper nut after adjustment.

C. C-Clamps:

- 1. Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.

D. Beam Clamps:

- 1. Tighten all set screws and lock nuts.
- 2. Hammer jaw firmly against underside of beam for Figure 127 only.

3.11 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.
- C. Non-stainless steel hanger and supports in process areas receive coatings in accordance with Section 09 96 00, High Performance Coatings.

*** END OF SECTION ***

1.00 GENERAL

1.01 DESCRIPTION OF WORK

- A. The work included in this section consists of furnishing and installing valves, operators, and piping specialties as specified herein and as indicated on the Drawings.
- B. Not all the valves and operators listed in this section are necessarily used for this project.

1.02 RELATED WORK

- A. Section 01 33 00 – Submittals Procedure
- B. Section 01 60 00 – Product Requirements
- C. Section 01 75 00 - Testing, Start-Up, and Training
- D. Section 09 96 00 – High Performance Coatings
- E. Division 26 – Electrical
- F. Division 40 – Process Interconnections

1.03 REFERENCE STANDARDS

- A. American Society of Mechanical Engineers:
 - 1. ASME B1.20.1 - Pipe Threads, General Purpose
 - 2. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings.
 - 3. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through 24 - Metric/Inch Standard.
- B. American Water Works Association (AWWA)
 - 1. American Water Works Association (AWWA) M44 Distribution Valves: Selection, Installation, Field Testing, and Maintenance, Latest Edition.
 - 2. AWWA Manual M49 Butterfly Valves: Torque, Head Loss, and Cavitation Analysis
 - 3. AWWA Manual M51 Air-Release, Air/Vacuum & Combination Air Valves
 - 4. AWWA Standard C500 Metal-Seated Gate Valves
 - 5. AWWA Standard C504 Rubber-Seated Butterfly Valves
 - 6. AWWA Standard C507 Ball Valves
 - 7. AWWA Standard C508 Swing-Check Valves

8. AWWA Standard C509 Resilient-Seated Gate Valves
9. AWWA Standard C512 Air-Release, Air/Vacuum & Combination Air Valves
10. AWWA Standard C515 Reduced-Wall, Resilient-Seated Gate Valves
11. AWWA Standard C516 Large-Diameter Rubber-Seated Butterfly Valves
12. AWWA Standard C517 Resilient-Seated Cast-Iron Eccentric Plug Valves
13. AWWA Standard C518 Dual-Disc Swing-Check Valves
14. AWWA Standard C520 Knife Gate Valves
15. AWWA Standard C530 Pilot-Operated Control Valves
16. AWWA Standard C541 Hydraulic and Pneumatic Cylinder and Vane-Type Actuators for Valves and Slide Gates
17. AWWA Standard C542 Electric Motor Actuators for Valves and Slide Gates
18. AWWA Standard C550 Protective Interior Coatings for Valves and Hydrants
19. AWWA Standard C800 Underground Service Line Valves and Fittings

1.04 SUBMITTALS

- A. Furnish submittals in accordance with Section 01 33 00 - Submittal Procedures.
 1. Product Data: Submit product data sheets for all items proposed for use.
 2. Wiring and plumbing diagrams.
 3. Valve Schedule: Submit final valve schedule that includes valve schedule tag number, location, size, and function.
- B. Operation and Maintenance Manuals: Furnish in accordance with Section 01 33 00 - Submittal Procedures.

C. Warranties: Installation and Manufacturer's Warranty

1.05 BIDDING

- A. The cost for valves, operators, and piping specialties shall be included in the bid items for each piping system or equipment item for which they are required, complete, operable, and coated.

1.06 WARRANTY

- A. Installation Contractor shall warrant the materials and installation to be free of defects in materials and workmanship for a period of two (2) years from the Date of Substantial Completion and in accordance with the General Conditions.

B. Manufacturer's Warranty: Contractor shall submit manufacturer's standard warranty for all products furnished.

2.00 **PRODUCTS**

2.01 **GENERAL**

A. The Contractor shall furnish and install all valves as shown and specified.

B. Undesignated Valves. Where indicated on the Drawings, Contractor shall furnish and install undesignated valves. Valves shall be first class quality and suitable for the indicated service. Valves shall be subject to approval of the Engineer.

C. Valve-operating units, stem extensions and other accessories shall be furnished and installed by the Contractor where shown, or where required in the opinion of the Engineer, to provide for convenience in operation.

D. Where buried valves are indicated, the Contractor shall furnish and install valve boxes to grade.

E. All valves shall be new and of current manufacture.

F. All exposed shut-off valves, 6 inch and larger, and valves with operating stands shall have geared operators with position indicators.

G. Where buried valves call for position indicators they shall be provided with valve boxes and covers containing position indicators.

H. The flanges of valves may be raised or plain faced.

1. Flanges of valves for water working pressures of 175 psi or less shall be faced and drilled to 125 lb. American Standard template.

2. Flanges of valves for water working pressures greater than 175 psi shall be faced and drilled to 250 lb. American Standard template.

I. Valves installed in grooved piping system shall be groove joint. Use of flanged adapters is not acceptable.

J. Unless otherwise specified, each valve body shall be tested under a test pressure equal to twice its design water working pressure.

K. Unless otherwise specified, all interior bronze parts of valves except gate valve stems shall conform to the requirements of the "Specification for Composition Bronze or Ounce Metal Castings", (ASTM B62). Gate valve stems shall be of bronze containing not more than 5% of zinc nor more than 2% of aluminum, and shall have a minimum tensile strength of 60,000 psi, a yield strength of 40,000 psi, and an elongation of at least 10% in 2 inches. Compliance shall be determined by a test coupon poured from the same ladle from which the valve stems to be furnished are poured.

- L. Except where otherwise provided, the exterior surfaces of all submerged valves shall be epoxy coated with 8 mils of "Scotchcoat" or Miccrow 650 or approved equal.
- M. Unless otherwise specified, interior coating of valves shall be fusion bonded epoxy coating minimum 15 mils DFT meeting AWWA C550-09 Protective Epoxy Interior Coating for Valves and Hydrants.
- N. Where designated, certain valves shall be furnished with electric operators provided by the valve manufacturer.
 - 1. All operators of a given type shall be furnished by the same manufacturer.
 - 2. Where these operators are supplied by different valve manufacturers, the Contractor shall coordinate their operator selections to provide uniformity of each type of electric operator.
 - 3. Operator sizing and operation shall be the responsibility of the valve manufacturer, who shall design the rating of the operator, the rate of operation, and other aspects.
 - 4. Care must be taken to assure that electric operators and controls for valves located in Classified Areas conform to restrictions to be explosion-proof if required.
- O. Valves and operators in particular locations may require a combination of units, sensors, limit switches and controls specified in this or in other divisions of these Specifications.
 - 1. It shall be the responsibility of the Contractor to properly assemble and install these various items so that all systems are compatible and operating properly.
 - 2. The relationship between interrelated items shall be clearly noted on shop drawing submittals.
- P. Unless specifically required to be equipped with other types of operators, all valves with centerline more than 6 feet above the operating floor shall be equipped with chain wheels and operating chains.
 - 1. Each chain wheel operated valve shall be equipped with a chain guide, which will permit rapid handling of the operating chain without "gagging" of the wheel.
- Q. A hanging bracket or hook shall be provided on an adjacent wall or structure to provide for securing the chain out of the walking area.
- R. Valves shall be identified in accordance with Section 40 05 53 – Identification of Process Piping and Equipment.
- S. Valves in piping systems shall be adequately supported to prevent their load from being imposed on any operating equipment, and in accordance with best practices to resist dislocation when adjacent piping or support is removed for maintenance, and to prevent injury to operation or maintenance personnel.

2.02 PLUG VALVES (STANDARD, 3-WAY, V-PORT)

A. Service

1. Mixed Liquor Recycle (MLSS)
2. Centrifuge feed (SL, WAS)

B. Manufacturer

1. Dezurik
2. Victaulic
3. Milliken Millcentric
4. Pratt
5. Engineer-approved equal.

C. General.

1. AWWA Standard C517 Resilient-Seated
2. All plug valves from single manufacturer.
3. Non-lubricated, eccentric-type
4. Joints:
 - a. 2" and less: screwed ends
 - b. 4" and greater, exposed: grooved ends AWWA C-606
 - c. 4" and greater, buried: mechanical joint ends

D. Construction.

1. Body and bonnet: Ductile or cast iron with raised seats
2. Seats: Welded-in overlay of high nickel content surfaces contacting the plug
3. Bearings: Permanently lubricated, Type 316 stainless steel
4. Design: Bolted bonnet
5. Packing: 4" and larger valves can be repacked without removing the bonnet, packing is adjustable.
6. All exposed nuts, bolts, springs and washers shall be zinc plated.

7. Flanges: ANSI B16.1 125-pound
8. Plug: Resilient faced plug, neoprene
9. Valves installed in solids lines shall be installed with the seat on the upstream side.

E. Operators.

1. Lever or gear actuators and tee wrenches, extension stems, floor stands, chain-wheels, etc., as required or indicated on the Plans.
2. Valves 4" or less may have lever or t-wrench operators.
3. Valves greater than 4" shall have gear operators.
4. All gearing shall be enclosed in a semi-steel housing and be suitable for running in a lubricant with seals provided on all shafts to prevent entry of dirt and water into the actuator.
5. The actuator shaft and the quadrant shall be supported on permanently lubricated bronze bearings.
6. Actuators shall clearly indicate valve position, and an adjustable stop shall be provided to set closing torque.
7. All exposed nuts, bolts and washers shall be zinc plated. Type and position of operators shall be approved by the Engineer for each valve.
8. Chain wheel and chain operators shall be provided for all valves with the operator 6' or greater above the floor. Chain hangers shall be mounted near all valves with chain wheel operators to allow hanging the chains out of operating areas.
9. Valves and gear actuators for buried or submerged service shall have seals on all shafts and gaskets on the valve and actuator covers to prevent the entry of water. Actuator mounting brackets for buried or submerged service shall be totally enclosed and shall have gasket seals. All exposed nuts, bolts, springs and washers shall be stainless steel.

2.03 KNIFE GATE VALVES

A. Service

1. Not used

D. Manufacturer

1. Dezurik or
2. Engineer-approved equal.

E. Type: Stainless Steel Resilient Seated

- F. Style: Lug
- G. Body: ASTM A351 CF8M
- H. Yoke: ASTM A351 CF8
- I. Knife: ASTM A240 316 SS
- J. Packing: PTFE
- K. Pressure Rating: 150 PSI
- L. Operator: Hand Wheel
- M. Design: MSS SP-81
- N. Flange Drilling: ANSI B16.5
- O. Material: ASME B16.34
- P. Operator: Hand wheel (chain required if greater than 5 feet above floor)

2.04 GATE VALVES (RESILIENT SEAT)

- A. Service:
 - 1. Utility Water (UW) System
 - 2. Pressure drain return (DP)
 - 3. Reject from Discfilter (RE)
 - 4. WAS connection (WAS)
 - 5. Clarifier Influent (CLI)
 - 6. Clarifier Effluent (CLE)
- D. Gate valves 2 inches and under shall have threaded or grooved ends unless specifically indicated otherwise on the drawings, and shall be 200 lb. WOG with bronze body and trim, union bonnet, rising stem and solid wedge disc.
- E. Gate valves 2&1/2 inches and over shall have grooved ends unless specifically indicated otherwise on the drawings, and shall be 200 lb. WOG with iron body, bronze trim, Resilient Seat or resilient wedge. Valve have fusion bonded epoxy coating.
- F. Valve for buried service shall comply with AWWA Standards for Resilient-Seated Gate Valves or resilient wedge gate valves with non-rising stem, mechanical joint ends with set screws, O-ring seals, 2-inch square nut and suitable cast iron valve box. Valves shall be Clow or equal.

2.05 MUD VALVES

A. Service:

1. Tank and Sump Gravity Drain (DG) lines

D. Manufacturer

1. Trumbull Industries, Inc.
2. Engineer-approved equal.

E. Material: Type 316 SS, passivated per ASTM A-380

F. Flanged connection, ANSI B16.1 125-pound

G. Seat: Resilient

H. Input torque: 450 foot-pounds

I. Leakage Rate: 1 quart per hour

J. Maximum stem torque: 35 foot pounds

K. Valves inside tanks shall be furnished complete with a non-rising extension stem, wall brackets, and operating nut so that the valve can be operated from above the basin. Valves in shallow sumps do not need extension stems, but shall be provided with an operating nut.

2.06 CAST OR DUCTILE IRON SWING CHECK VALVES

A. Service – on each pump discharge:

1. Utility Water (UW) System
2. Filter feed lift station (FF) System
3. Mixed liquor recycle (MLSS)

D. Manufacturer

1. DeZurik, Sartell MN
2. Victaulic, Easton, PA
3. Henry Pratt Company, Aurora IL
4. Kennedy Valve Company, Elmira NY
5. Mueller Company, Chattanooga TN
6. Val-Matic Valve & Manufacturing, Elmhurst IL

- 7. Engineer-approved equal
- E. Description
 - 1. AWWA C508
 - 2. Type: Swing, resilient-seated, with outside lever and adjustable weight.
 - 3. Pressure Rating: 200 psig
 - 4. Flow Area: Full open, equal to connecting nominal pipe diameter.
 - 5. Mounting: Horizontal or vertical
 - 6. End Connections: ASME B16.1, flanged, or grooved per ANSI/AWWA C606
- F. Materials:
 - 1. Body and Cover: ASTM A126, cast iron or ASTM A536, ductile iron
 - 2. Disc: 316 Stainless Steel
 - 3. Seat: Buna-N/NBR, ASTM D2000
 - 4. Hinge Pin and Key: 316 Stainless steel
 - 5. Packing and O-Ring: Buna-N/NBR
 - 6. Connecting Hardware: Type 316 stainless steel
 - 7. Interior/Exterior Coating: Fusion-Bonded Epoxy Coating (MFE/BP)
- G. Factory Testing: Testing shall be performed in accordance with AWWA C-508.

2.07 COMBINATION WAFER SWING CHECK VALVES

- A. Service
 - 1. N.A.
- D. Manufacturer
 - 1. Bray/Ritepro Corporation or
 - 2. Engineer-approved equal.
- E. Style: Wafer
- F. Body: ASTM A351 CF8M
- G. Disc: ASTM A351 CF8M

- H. Shaft: ASTM A479-316
- I. Seat: EPDM
- J. Pressure Rating: 125 PSI
- K. Accessories: Dual weights for low flow applications

2.08 AIR BUTTERFLY VALVES.

- A. Manufacturer:
 - 1. Keystone High Performance
 - 2. Bray High Performance, or
 - 3. Engineer-approved equal.
- B. Service Temperature: 300 deg F minimum (seats and seals shall be rated for this temperature).
- C. Style: Lug
- D. Body: 316 SS
- E. Disc: 316 SS
- F. Shaft: 17-4 PH SS
- G. Seat: RTFE
- H. Backing Ring: SS
- I. Packing: PTFE
- J. Suitable for air tight shut-off
- K. Operator: Geared operator with handwheel, or chain operated wheel if 6' or greater above the floor.

2.09 BUTTERFLY VALVES FOR LIQUID SERVICE

- A. Service
 - 1. Discfilter Tank Feed, filter isolation (FF)
 - 2. Utility Water (UW)
- D. Manufacturer
 - 1. Bray Series 30/31

- E. Style: Lug Pattern
- F. Body: Epoxy Coated Cast Iron
- G. Disc: 316 Stainless Steel
- H. Shaft: 416 SS
- I. Seat: EPDM
- J. Bi-directional Pressure Rating, minimum: 150 PSI
- K. Manual Operator: Series 5 declutchable manual gear operator

2.10 PNEUMATIC ACTUATORS (DOUBLE-ACTING)

- A. Manufacturer
 - 1. Bray Series 92/93 or
 - 2. Engineer-approved equal.
- B. Supply Pressure: 550 kPa (80 psig)
- C. Body Material: Extruded Aluminum Alloy, Anodized
- D. Travel Stop: Alloyed Steel
- E. End Caps: Die Cast Aluminum Alloy
- F. Pistons: Die Cast Aluminum Alloy
- G. Output Shaft: Carbon Steel (Zinc Plated)
- H. Shaft Bearings: Acetal
- I. Fasteners: Stainless Steel
- J. 'O' rings: Buna-N
- K. Air Solenoid: 4-way, NEMA 4, 120Vac/1ph/60Hz or equal
- L. Air Supply Connections: ¼" NPT, 2 places
- M. Limit Switches: One fully open, one fully closed Bray Series 50 switch box
- N. Additional Features: Open and closing speed control
- O. Position Control:
 - 1. Electro-pneumatic Bray Series 6A Analog Positioner

2. 4-20mA Input
 3. NEMA 4 Enclosure
- 2.11 PRESSURE-REGULATING VALVES
- A. Service: Utility Water (UW)
 - B. Pressure-regulating valves shall be full line size indicated with adjustable range to suit the installation.
 - C. Reduced pressure range for water lines shall be nominally 25 to 75 PSI, unless otherwise required or specified.
 - D. Valves in water lines up to 3”:
 1. Manufacturer: Zurn/Wilkens Model 500XL
 2. Direct-acting with sealed spring.
 3. Stainless steel seat trim, 300 series
 4. Reinforced neoprene diaphragm
 5. Cast bronze body, ASTM B 584
 6. NPT threaded connections.
- 2.12 BACKFLOW PREVENTER VALVE (DOUBLE CHECK VALVE ASSEMBLY)
- A. Service: Utility Water (UW)
 1. Manufacturer: Zurn/Wilkens Model 350A or
 2. Engineer-approved equal.
 - D. Standard: AWWA C510
 - E. Main valve body: Ductile Iron ASTM A 536 Grade 4
 - F. Access covers: Ductile Iron ASTM A 536 Grade 4
 - G. Internals: Stainless steel, 300 Series
 - H. Fasteners and springs: Stainless Steel, 300 Series
 - I. Seal ring: EPDM
 - J. O-ring: Buna Nitrile
 - K. Maximum working pressure: 175 PSI

L. Connections: Grooved, AWWA C606.

M. Isolation valve type: Gate

2.13 AIR RELEASE VALVES

A. Manufacturer:

1. Valmatic
2. Engineer-approved equal

B. Type: Automatic Float

C. Standard: AWWA C512

D. Body: 316 SS

E. Trim: 316 SS

F. Orifice: Viton

G. Connections: NPT Threaded

H. Pressure Rating: 150 PSI

2.14 STAINLESS STEEL BALL VALVES

A. Manufacturer:

1. Bray-FlowTek
2. Valtorc
3. Engineer-approved equal

B. Type: Ball Valve

C. Ports: Full

D. Body, Ball, Stem: 316 SS

E. Seat: Reinforced Teflon

F. End Connections: NPT Threaded

G. Pressure Rating: 150 PSI

H. Temperature Range: -50°F to 450°F

I. Manual Operators: Manual Lever

2.15 CPVC BALL VALVES

- A. Service:
 - 1. Chemical Feed Systems
 - 2. Turbidimeter Feed Valves (MFE)
 - 3. Dilution Water to Chemical Feed Systems (WU)
- B. Manufacturer:
 - 1. George Fischer
 - 2. Chemline Plastics
 - 3. Engineer-approved equal
- C. Style: True-Union
- D. Port: Full
- E. Body, Ball, Stem: CPVC
- F. Seats: PTFE
- G. Seals: EPDM (chemical pending)
- H. End Connections: NPT Threaded
- I. Pressure Rating: 150 PSI
- J. Manual Operators: Manual Lever
- K. Pneumatic Actuators: Spring-Return
- L. Electric/Solenoid Operators:
 - 1. Manufacturer: Same as Valve
 - 2. Enclosure: NEMA 4X
 - 3. 110-115VAC
 - 4. Manual Override on Actuator
 - 5. Fail Open or Closed as Required

2.16 CPVC CHECK VALVES

- A. Service

1. Chemical Feed Systems
 2. Dilution Water to Chemical Feed Systems (WU)
- B. Manufacturer:
1. George Fischer
 2. Chemline Plastics
 3. Engineer-approved equal
- C. Style: Ball or Swing Check
- D. Body, Disc: CPVC
- E. Seal: EPDM
- F. Ends: True Union Threaded
- G. Pressure Rating: 150 PSI
- 2.17 CPVC PRESSURE REGULATING VALVES
- A. Service:
1. Chemical Feed Systems
 2. Dilution Water to Chemical Feed Systems (WU)
- B. Manufacturer:
1. George Fischer
 2. Chemline Plastics
 3. Engineer-approved equal
- C. Type: Pressure Reducing and Regulating, Spring-Loaded with Adjusting Screw
- D. Body: CPVC, PP, or PVDF
- E. Diaphragm: EPDM or PTFE as required by chemical
- F. Seals: EPDM
- G. Ends: True Union Threaded Socket
- H. Pressure Rating at Service Temperature: 150 PSI
- I. Set Pressure Ranges: 5-150 PSI

2.18 CPVC BACKPRESSURE/PRESSURE RELIEF VALVES

- A. Service: Chemical Feed Systems
- B. Manufacturer:
 - 1. George Fischer
 - 2. Chemline Plastics
 - 3. Engineer-approved equal
- C. Type: Back Pressure/Relief, Spring-Loaded with Adjusting Screw
- D. Body: CPVC, PP, or PVDF
- E. Diaphragm: EPDM or PTFE as required by chemical
- F. Seals: EPDM
- G. Ends: True Union Threaded Socket
- H. Pressure Rating at Service Temperature: 150 PSI
- I. Set Pressure Ranges: 5-150 PSI

2.19 HOSE BIBBS

- A. Hose bibbs shall be threaded, minimum 1-inch, and galvanized steel. Provide hose rack and sign near hose bibb per the drawing details.

2.20 VALVE BOXES

- A. Valve boxes, except those of special design as required by the Plans, shall be of cast iron of the two piece (minimum) extension type with cast iron cover. The extension shall provide for the maximum depth of cover over the pipe in which the valves are to be used. Valve boxes shall have walls not less than 3/16 inch thick at any point, and the internal diameter shall be not less than 5 inches. Valve box covers shall have the word "SEWER" or "WATER" cast into them as appropriate to their place of use. All valves underground shall be installed with valve boxes.
- B. Where valves are buried greater than 6' below the ground surface (top of 2" operating nut" greater than 4' below ground surface), extended stems shall be provided and installed for operating nut to be 3' below top of valve box.
- C. All reclaimed water valve box covers shall be color coded or painted purple [Pantone 522 or otherwise approved by the Engineer], and shall have the word "Reclaimed Water" cast into them, unless otherwise directed by the Engineer.

2.21 SPECIAL TOOLS AND SPARE PARTS

- A. Provide key for all valve operators and boxes as required to operate all valves furnished in this contract.

3.00 EXECUTION

3.01 INSTALLATION

- A. Contractor shall install the valves specified herein in accordance with the Manufacturer's recommendations and drawings.
- B. Install globe, butterfly, plug, ball, gate, and check valves in water piping in accordance with AWWA M44.
- C. Install air-release, air/vacuum & combination air valves in accordance with AWWA M51.

3.02 COATING

- A. The valves, unless otherwise specified, shall be shop primed and painted in accordance with Section 09 96 00, High Performance Coatings.

3.03 TESTING

- A. All valves in water piping shall be hydrostatically pressure tested in accordance with Section 40 05 01 Piping and Plumbing Testing.
- B. On-site testing of pneumatic operators shall comply with the requirements of Section 01 75 00, Equipment Testing and Start-Up.
- C. Manufacturer's qualified service representative shall certify the installation and on-site testing of the pneumatic operators in accordance with Section 01 75 00, Testing, Start-Up, and Training.

3.04 TRAINING

- A. Manufacturer's qualified service representative shall provide a minimum of four (4) hours of training of the Owner's staff for operation and maintenance of the pneumatic valve operators if used.
- B. Training shall meet the requirements of Section 01 75 00, Testing, Start-Up, and Training.

*** END OF SECTION ***

1.00 GENERAL

1.01 DESCRIPTION OF WORK

- A. The work covered by this section consists of furnishing all labor and materials required for the color coding and identification of mechanical and electrical systems as shown on the drawings and as specified in other Divisions.
- B. Identification materials shall include:
 - 1. Pipe Markers
 - 2. Duct Markers
 - 3. Valve and Gate Tags
 - 4. Equipment Tags
 - 5. Equipment and Motor Nameplates

1.02 RELATED WORK

- A. Section 01 33 00 – Submittal Procedures
- B. Section 01 60 00 – Product Requirements
- C. Section 09 96 00 - High Performance Coatings
- D. Divisions requiring color coding and identification include, but are not limited to, the following:
 - 1. Section 21 13 13 - Fire-Suppression Sprinkler System
 - 2. Division 22 - Plumbing
 - 3. Division 23 – HVAC
 - 4. Division 26 – Electrical
 - 5. Division 33 – Utilities
 - 6. Division 40 - Process Integration
 - 7. Division 41 - Material Processing and Handling Equipment (Cranes and Hoists)
 - 8. Division 43 - Process Gas and Liquid Handling Storage and Equipment
 - 9. Division 46 - Water and Wastewater Equipment

1.03 REFERENCES

IDENTIFICATION FOR PROCESS PIPING AND EQUIPMENT

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- A. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:
- B. ANSI – American National Standards Institute
 - 1. ANSI / ASME A13.1: “Scheme for the Identification of Piping Systems”
 - 2. ANSI Z535.1 - Safety Color Code
 - 3. ANSI Z535.2 - Environmental and Facility Safety Signs
 - 4. ANSI Z535.3 - Criteria for Safety Symbols
 - 5. ANSI Z535.4 - Product Safety Signs and Labels
- C. NFPA - National Fire Protection Association
 - 1. NFPA 99C - Standard on Gas and Vacuum Systems
- D. ASTM – American Society for Testing and Materials
 - 1. ASTM F992 - Specification for Valve Label Plates

1.04 SUBMITTALS

- A. Submittals shall be submitted in accordance with Section 01 33 00 - Submittal Procedures.
- B. Product Data:
 - 1. Submit product data and samples for all identification materials indicating all dimensions and materials.
 - 2. Submit list of wording, symbols, letter size, and color coding for mechanical identification.
 - 3. Provide manufacturers catalogue literature for each product required.
- C. Valve Schedule: Submit final valve schedule that includes valve schedule tag number, location, size, and function.
- D. Samples: Submit one sample of each type of pipe and duct marker, valve and equipment tag, and equipment and motor nameplate.

E. Manufacturer's Installation Instructions: Indicate special procedures and installation instructions.

1.05 BIDDING

- A. The cost for identification shall be included as a separate bid item for each area.

1.06 WARRANTY

- A. Installation Contractor shall warrant the materials and installation to be free of defects in materials and workmanship for a period of one (1)-year from the Date of Substantial Completion and in accordance with the General Conditions.
- B. Manufacturer's Warranty: Furnish and submit manufacturer's standard warranty.

2.00 PRODUCTS

2.01 MANUFACTURER

- A. Seton Identification Products, Branford, CT
- B. Brady Corporation, 6555 W. Good Hope Rd, Milwaukee, WI 53223
- C. Brimar Industries, Inc., Garfield, NJ

2.02 PIPE MARKERS

- A. Mechanically Fastened Pipe Markers:
 - 1. Vinyl: Factory fabricated vinyl, preformed to fit around pipe or pipe covering. Model: Setmark by Seton.
 - 2. Polyester: Factory fabricated polyester, 0.1 mm (4 mil) thick, laminated with UV-resistant poly vinyl fluoride (PVF), preformed to fit around pipe or pipe covering. Model: Ultramark, by Seton.
- B. Nylon Ties: Clear, 6 to 11 inches long, nonconductive, locking type.
- C. Color and Text:
 - 1. Piping: to ASME A13.1.
 - 2. Gas Piping: NFPA 99C.
- D. Identify:
 - 1. Fluid being conveyed.
 - 2. Flow direction arrow.
 - 3. Language: English.
 - 4. Lettering: Size and color to ASME A13.1.

2.03 DUCT MARKERS

- A. Self-Adhesive Pipe Markers (Labels):

1. Polyester: Factory fabricated polyester, 0.05 mm (2 mil) thick, coated with acrylic adhesive. Model: Poly-Code, by Seton.

B. Color and Text:

1. ASME A13.1.

C. Identify:

1. Air being conveyed (e.g., Exhaust Air, Intake Air, Outside Air, Relief Air, Return Air, or Supply Air)
2. Flow direction arrow.
3. Language: English.

2.04 VALVE AND GATE TAGS

A. Material: Stainless Steel

B. Thickness: 0.6 mm (0.025 inch)

C. Size: 2-inch diameter

D. Lettering: Stamped letters; character size and words to ANSI A13.1.

E. Mounting: 3/16" diameter side hole

F. Fastener: Stainless steel beaded chain, 114 mm (4-1/2") long, with locking link.

2.05 EQUIPMENT TAGS

A. Equipment Tags: Provide an equipment tag with schedule number for all mechanical and electrical equipment including:

1. Equipment,
2. Pumps,
3. Blowers,
4. Fans,
5. Heaters,
6. Motorized dampers,
7. Apparatus cabinets,
8. Switchgear,

9. Transformers,
 10. Control panels, and
 11. Flow meters.
- B. Material: Electrically non-conductive phenolic plastic with beveled edges.
- C. Temperature rating: 200°F
- D. Thickness: 1/16"
- E. Size: 4" wide x 2" high
- F. Text Size: 1/2"
- G. Color: White with black letters.
- H. Mounting for mechanical equipment: 3/16" diameter side hole with stainless steel beaded chains with locking link.
- I. Mounting for panels and cabinets: 2 mil permanent acrylic adhesive.

2.06 EQUIPMENT AND MOTOR NAMEPLATES

- A. Manufacturer's Nameplate: Furnish nameplate for each piece of equipment and its motor fastened in a readily readable position.
- B. Material: Stainless steel, 0.032 inches thick.
- C. Identification:
1. Equipment: Manufacturer's name, model, serial number, size, head or pressure rating, capacity, speed, impeller diameter, frame and bearing numbers.
 2. Motors: Manufacturer's name, model, serial number, running current, starting current, horsepower, voltage, frequency, phase, and speed.
 3. Lettering: Stamped or Etched.
 4. Language: English.
- D. Size: 4" wide x 2" high
- E. Color: Black
- F. Mounting: Four 3/16" diameter side holes.
- G. Fasteners: Stainless steel screwed into inserts, anchor shields or tapped holes in equipment or base.

3.00 EXECUTION

3.01 INSTALLATION

- A. Install the materials specified herein in accordance with the Manufacturer's recommendations.

3.02 PIPING MARKERS

- A. Identify all piping, concealed or exposed. Insulated pipe shall be identified as required for the carrier pipe.
- B. Include service and flow direction with arrow. For pressure lines above 250 PSI, provide pressure.
- C. Identify piping 20 mm (3/4 inch) diameter and smaller with tags.
- D. Provide snap-on type for pipes 150 mm (6") and smaller. Use strap-on type for pipes over 150 mm (6") in size.
- E. Provide wrap-around polyester pipe markers for corrosive areas, chemical containment areas, outdoor pipes, and pipes carrying chemicals. Install wrap-around pipe markers completely around pipe.
- F. Install in clear view and align with axis of piping.
- G. On overhead piping, provide markers on the lower portion of the pipe where view from the floor is unobstructed.
- H. Locate identification at maximum 20 feet on centers on straight runs.
- I. Provide markers and arrows at the following locations:
 - 1. Risers and drops,
 - 2. Adjacent to each damper, tee, and changes in direction,
 - 3. At each side of penetration of structure, enclosure, walls, floors or ceilings,
 - 4. And at each obstruction, and
 - 5. Behind every access door or panel.

3.03 DUCT MARKERS

- A. Identify all ducting, concealed, exposed, or insulated.
- B. Include service and flow direction with arrow.
- C. Install in clear view and align with axis of ducting.

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- D. Provide markers on the lower portion of the duct where view from the floor is unobstructed.
- E. Locate identification at maximum 20 feet on centers on straight runs.
- F. Pipe markers and arrows shall be provided at the following locations:
 - 1. Risers and drops,
 - 2. Adjacent to each valve and tee,
 - 3. At each side of penetration of structure, enclosure, walls, floors or ceilings;
 - 4. And at each obstruction.
 - 5. Behind every access door or panel.

3.04 VALVE TAGS

- A. All interior, exterior, and buried valves shall be provided with identification tags.
- B. Tags for buried valves shall be secured to the underside of the valve box cover.
- C. Attach tags so they are easily visible but do not obstruct the operation of the valve.

3.05 EQUIPMENT TAGS

- A. For adhesive applied labels:
 - 1. Degrease and clean surfaces to receive adhesive.
 - 2. Remove backing release tape.
 - 3. Apply configured label to substrate surface with full contact.
 - 4. Press or roll firmly to assure full surface bond.

***** END OF SECTION *****

1.00 GENERAL

1.01 DESCRIPTION OF WORK

- A. The work included in this section consists of furnishing and installing hydraulic gates, operators and weirs as specified herein and as indicated on the Drawings.
- B. Not all the gates and operators listed in this section are necessarily used for this project.

1.02 RELATED WORK

- A. Section 01 33 00 – Submittals Procedure
- B. Section 01 75 00 - Testing, Start-Up, and Training.
- C. Section 01 60 00 - Product Requirements
- D. Section 05 50 00 – Metal Fabrications
- E. Section 09 96 00 – High Performance Coatings

1.03 REFERENCES

- A. American Water Works Association (AWWA) C-501 Standard for Sluice Gates
- B. American Water Works Association (AWWA) C-560 Standard for Cast-Iron Slide Gates
- C. American Water Works Association (AWWA) C-561 Standard for Fabricated Stainless Steel Slide Gates

1.04 SUBMITTALS

- A. Furnish submittals in accordance with Section 01 33 00 - Submittal Procedures.
- B. Product Data: Submit product data sheets for all gates, weirs, and operators.
- C. Shop Drawings: Drawings showing the dimensions, structural supports, fasteners, concrete embedments and inserts, weights, materials of construction for all gates, weirs, and operators.
- D. Design Calculations in compliance with AWWA standards latest edition: Operator torque input, lift, and stem calculations.
- E. Gate Schedule: Submit final gate schedule that includes gate schedule tag number, location, size, and function.
- F. Operation and Maintenance Manuals: Furnish in accordance with Section 01 33 00 - Submittal Procedures.
- G. Warranties: Installation and Manufacturer's Warranty.

1.05 QUALIFICATIONS

- A. The manufacturer shall have 10 years of experience in the production of substantially similar equipment, and shall show evidence of satisfactory operation in at least 10 installations.
- B. The manufacturer's shop welds, welding procedures and welders shall be qualified and certified in accordance with the requirement of the latest edition of AWS Sections D1.1, 1.2 and 1.6.

1.06 BIDDING

- A. The cost for gates, weirs, and operators shall be included in the bid items for each for each area, complete, operable, coated, and tested.

1.07 WARRANTY

- A. Installation Contractor shall warrant the materials and installation to be free of defects in materials and workmanship for a period of two (2)-years from the Date of Substantial Completion and in accordance with the General Conditions.
- B. Manufacturer's Warranty: Contractor shall submit manufacturer's standard warranty for all products furnished.

2.00 PRODUCTS

2.01 GENERAL

- A. The Contractor shall furnish and install all gates as shown and specified.
- B. All gates shall be adequately braced to prevent warpage and bending under the intended use.
- C. All gates with operating stands shall have geared operators with position indicators.
- D. Where designated, certain gates shall be furnished with electric operators provided by the gate manufacturer. All operators of a given type shall be furnished by the same manufacturer.
- E. Operator sizing and proper operation shall be the responsibility of the gate manufacturer, who shall design the rating of the operator, the rate of operation and other aspects.
- F. Gates shall be identified in accordance with Section 40 05 53 – Identification of Piping and Equipment.

2.02 STOP GATES AND GUIDE FRAMES

- A. Wall mounted hand lift stop gates, including "insert" mounted hand lift stop gates, shall be fabricated of 1/4 inch 316 stainless steel as shown and shall be reinforced as necessary to assure long life under the specified operating conditions.
- B. Guide frames shall be 316 stainless steel, of size and types shown in Plans, with factory-welded fabrication or combination welded bolted fabrication. All surfaces shall be mill or smooth finish. All surfaces in contact with concrete shall have one shop coat of unthinned bitumastic paint, Koppers 50. All other surfaces shall be mill finish.

- C. Guides shall include resilient neoprene seal securely attached to the frame along the invert, and shall extend to the depth of the guide groove for seal on closure. Vertical guides shall be furnished with ultra high molecular weight (UHMW) polymer seats, which contact the slide face to provide additional water tightness.
- D. Mounting hardware shall be of size and type recommended by the manufacturer and shall be furnished as part of the factory-drilled guide frame.
- E. Gates fitting frames of the same size shall be interchangeable to allow operating flexibility.
- F. Gates shall have welded rod handles unless otherwise specified. Two handles shall be provided for gates over 3'0" width. Handles shall be 6"± extended above top of gate. Top of handles shall not interfere with grating over channels containing gates.
- G. Stainless steel stop gates and stainless steel guides shall be by Fontaine™, Fresno Gate and Valve Co., Waterman, Golden Harvest, or approved equal.

2.03 SLUICE GATES

- A. Performance: Sluice gates shall be substantially watertight under the design head conditions. Under the design seating/unseating head, the leakage shall not exceed 0.005 gallons per minute per foot of seating/unseating perimeter.
- B. Gates, unless otherwise specified, shall be of heavy duty 316 stainless steel construction and shall comply with AWWA C561 or C501.
- C. Sluice gates shall be configured and rated as shown on the drawings, or approved equal.
- D. The gates shall be either non-self-contained with separate stem guides and pedestal operators or self-contained depending on the location. Specific gate configuration shall be as noted on gate schedule or as shown on the plans.
- E. Minimum material thickness shall be ¼".
- F. All gate assembly hardware and anchor bolts shall be 316 stainless steel.
- G. Gates shall be provided with an adjustable wedging system on the sides and along the top and bottom of the opening as needed.
- H. Materials:
 - 1. Slide, spigot, frame, stiffeners, yoke, guide angles: Stainless Steel Type 316L ASTM A-276
 - 2. Side and Top seals: Neoprene ASTM D-2000
 - 3. Invert seal: neoprene ASTM D-2000
 - 4. Bearing bars, guides, stem guide liner: Ultra High Molecular Weight Polyethylene ASTM D4020

5. Bottom seal: Neoprene ASTM D-2000
 6. Threaded stem, stem guides: Stainless steel ASTM A-276, Type 316L
 7. Fasteners: Stainless Steel Type 316L
 8. Pedestal: Cast Iron ASTM A126, Class B or Mild Steel A36/A36M
 9. Stem cover: Butyrate ASTM D2411
 10. Lift and stop nut: Manganese Bronze, ASTM B584, UNS-C86500
- I. Frame: The gate frame shall be stainless steel and designed for maximum rigidity. The frame configuration shall be of the flush-bottom type and shall allow the replacement of the top and side seals without removing the gate frame from the wall or wall thimble.
- J. Slide: The slide shall consist of stainless steel plate reinforced to limit its deflection to 1/720 of the gate's span under the design operating head. A neoprene resilient seal shall be attached to the bottom of the slide and be held in place with a stainless steel retainer bar.
- K. Wedges: Gates shall have a minimum of two intermediate top wedges. Wedges shall be stainless steel with ultra-high molecular weight polyethylene faces and be fully adjustable.
- L. Guides, Pressure Bars and Seals: The guides shall be provided shall be of such length as to retain and support at least two thirds (2/3) of the vertical height of the slide in the fully open position. Guide frame shall not weigh less than 13 lbs. per foot.
- M. UHMW pressure bars shall be located inside the vertical guides. Jack bolts with locking bolts shall be provided for adjustability and to insure permanent setting.
- N. Side and top seals shall be frame mounted and fully adjustable. Seals shall be resilient neoprene of the crown-type with a stainless steel retainer bar. Self-Adjusting compression cord seals or winged UHMW seals will not be considered.
- O. The flush bottom resilient neoprene seal shall be mounted to bottom of disc and seal against the invert portion of the frame. Frame mounted invert seals will not be considered.
- P. Yoke and Pedestal: The yoke, to support the operating bench stand, shall be formed by two structural members welded at the top of the guides to provide a one piece rigid frame.
- Q. Self-contained gates shall be provided with a yoke to support the operating bench stand. The yoke shall be formed by two structural members welded at the top of the guides to provide a one piece rigid frame. The maximum deflection of the yoke shall be 1/720 of the gate's span.
- R. Non-self-contained gates shall be provided with pedestal mounted lifts. Pedestal shall be cast iron or mild steel and provided with shop coating.
- S. Stem and Couplings:

1. The operating stem shall be of stainless steel designed to transmit in compression at least 2 times the rated output of the operating manual mechanism with a 40 lb effort on the crank or hand wheel.
 2. The stem shall have a slenderness ratio (L/R) less than 200. The threaded portion of the stem shall have Acme type cold rolled threads with a maximum surface of 16 micro-inches.
 3. Stems in more than one piece shall be joined together by solid couplings.
 4. Gates having a width equal to or greater than two times their height shall be provided with two lifting mechanisms connected by a tandem shaft.
- T. Stem Guides: Stem guides shall be fabricated from stainless steel. Stem guides shall be equipped with a UHMW bushing. Guides shall be adjustable and spaced in accordance with the manufacturer's recommendation. The L/R ratio shall not be greater than 200.
- U. Stem Cover: Rising stem gates shall be provided with a clear polycarbonate stem cover. The stem cover shall have a cap and condensation vents and a clear mylar position indicating tape. The tape shall be field applied to the stem cover after the gate has been installed and positioned.
- V. Lifting Mechanism: Operators of the types listed in the schedule shall be provided by the gate manufacturer. Each manual operator shall be designed to operate the gate under the maximum specified seating and unseating heads by using a maximum effort of 40 lb on the crank or handwheel, and shall be able to withstand, without damage, an effort of 80 lb.

2.04 GEARED OPERATORS

- A. Sluice gates shall be provided with geared lifts as specified within this section and as shown on the drawings and in the gate schedule.
- B. All bearings and gears shall be totally enclosed in a weather tight housing. Operator housing shall be cast steel or cast iron.
- C. The pinion shaft of crank-operated mechanisms shall be supported by roller bearings.
- D. The operating shaft shall be fitted with a 2 inch square operating nut and removable crank. The crank shall be fitted with a corrosion-resistant rotating handle. The maximum crank radius shall be 15 inches and the maximum handwheel diameter shall be 24 inches.
- E. Geared operators shall have either a single or double gear reduction, depending upon the lifting capacity required.
- F. Operators shall be furnished with a threaded bronze lift nut to engage the threaded portion of the stem. The lift unit shall be flanged and supported on non-metallic thrust washers, ball or roller bearings to take the thrust developed during opening and closing of the gate.
- G. Pedestals shall be of high grade cast iron or fabricated stainless steel with ample base area. The gear and driving unit case shall be of high grade cast iron or cast steel. Pedestal and gear unit driving case shall be water and dust tight.

- H. Gate submittal shall include calculations showing:
 - 1. Torque required for lifting
 - 2. Stem deflection under 200 lb pull on operator handle with gate in closed position
Calculations shall show maximum stem deflection shall not exceed 0.5 inches.
- I. Gears shall be provided with machine cut teeth designed for smooth operation. The gearing and lift nut shall be mounted in a housing, which shall be separately supported on another structure or pedestal. Lubrication fittings shall be provided to permit lubrication of all gears and bearings.
- J. Gates which have a width exceeding twice the slide height shall be furnished with tandem interconnected operators with a single input crank.
- K. All operators shall be finished with a graduated, clear plastic stem cover.
- L. Gates where the operator is not mounted at a walking surface shall have extended crank stems and supports at the walkway where operation is intended, as shown on the drawings.
- M. Gates where the operating level is outside of the tank wall from the gate shall have geared bench-stand type operators at the top of the wall on top wall mounting brackets, with the operating shaft extended to outside of the wall. There the extended shaft shall be operated by either:
 - 1. Two right angle gear boxes to a hand crank shaft lower on the wall; or
 - 2. By an enclosed chain drive with sprockets on the upper and lower shafts, with the lower chain sprocket driven by a horizontal crank shaft.
 - 3. Crank shaft shall be located 3'0"± above the walking surface at the lower outside wall location. Shaft shall be suitable for operation by portable electric operator. Grease fittings for each of the operators shall have extended grease tubes and zirks extended to an operator accessible location outside of the basin wall.
- N. Extended shafts for special lift variations shall have universal joints, as appropriate, to accommodate slight misalignment between geared operators and or right angle gear boxes.

3.00 EXECUTION

3.01 INSTALLATION

- A. Contractor shall install the gates specified herein in accordance with the Manufacturer's recommendations and drawings.
- B. All Gate guides shall be installed square and level and shall be flush with appropriate surfaces.
- C. Gates shall fit securely and provide tight leak free shutoff around edges and at bottom.
- D. Stop gates with frames of the same dimension shall be interchangeable between locations. Stop gate hangers shall be provided in the proximity of gate locations as shown on the drawings.

- E. All gates shall be final adjusted to minimize leakage following initial water testing of pipes or structures, and prior to placement of pipes or structures into use.
- F. Gates shall be hydraulically tested by filling the adjacent structure with water and letting the gate hold the water for a minimum of 24 hours. Evidence of excess leakage shall require the Contractor to adjust the gates and retest.
- G. Manufacturer's representative shall provide services during installation, inspect the installation, and provide a Certification of Installation and Testing as specified in Specification Section 01 75 00, Testing, Start-Up, and Training. Manufacturer's representative shall be present on-site during hydraulic testing for the gates and shall certify the testing.

3.02 COATING

- A. The gate operators, unless otherwise specified, shall be shop primed and painted in accordance with Section 09 96 00, High Performance Coatings.

3.03 TESTING

- A. On-site testing shall comply with the requirements of Section 01 75 00, Equipment Testing and Start-Up.
- B. Manufacturer's qualified service representative shall certify the installation and on-site testing in accordance with Section 01 75 00, Testing, Start-Up, and Training.
- C. Field Leakage Test. A field leakage test may be performed by the purchaser after installation of the slide gate. The manufacturer shall be notified of the test so as to allow sufficient time to enable a representative of the manufacturer to be present at the test site. After all adjustments have been made and the mechanism properly lubricated, each gate slide shall be operated through one complete cycle as a final check on proper operation before starting the leakage test. Seating and unseating heads shall be measured from the top surface of the water to the center of the gate. The minimum duration of the hydraulic test shall be 24 hours. Under the design head, seating or unseating, as specified, the leakage shall not exceed the leakage rate specified in gpm/ft of seating perimeter listed in the specifications for the gate type.

3.04 TRAINING

- A. Manufacturer's qualified service representative shall provide a minimum of four (4) hours of training of the Owner's staff for operation and maintenance of the gates and operators.
- B. Training shall meet the requirements of Section 01 75 00, Testing, Start-Up, and Training.

*** END OF SECTION ***

1.00 GENERAL

1.01 DESCRIPTION OF WORK

- A. This section specifies the general requirements for liquid handling equipment and materials, unless otherwise specified elsewhere in the Specifications.

1.02 RELATED WORK

- A. Other divisions and sections where these product requirements are applicable, unless specified otherwise therein, include, but are not limited to, the following:

1. Section 01 33 00 – Submittal Procedures
2. Section 01 75 00 – Testing, Start-Up, and Training
3. Section 03 30 00 – Cast-in-Place Concrete: Equipment support (housekeeping) pads.
4. Section 05 50 00 – Metal Fabrications
5. Division 40 - Process Interconnections
6. Division 43 - Process Gas and Liquid Handling and Storage Equipment
7. Division 46 - Water and Wastewater Equipment

1.03 REGULATORY REQUIREMENTS

- A. The equipment and materials furnished shall be subject to the requirements of applicable portions of the following regulatory agencies:

1. Underwriters Laboratories (U.L.)
 - a. All equipment and devices shall be listed by and bear the Underwriters Laboratories (U.L.) Inc U.L. label or the CSA-C/US label.
2. State of Washington Department of Labor and Industries
 - a. Equipment not carrying these labels shall be labeled or listed by an approved agency as required by State of Washington Department of Labor and Industries.
3. National Fire Protection Association
 - a. National Electrical Code (NEC)
4. Occupational Safety and Health Administration:
 - a. 29 CFR 1910 - Occupational Safety and Health Act (OSHA)
5. Washington State Department of Labor and Industries

- a. Chapter 49.17 RCW - Washington Industrial Safety and Health Act (WISHA)
 - 6. International Building Code (IBC) by International Code Council:
 - a. All equipment is to be designed for the project seismic zone in accordance with the latest edition of International Building Code.
 - b. Calculations demonstrating this requirement shall be furnished to the Engineer if requested.
- 1.04 REFERENCE STANDARDS
- A. The work in this section is subject to the requirements of applicable portions of the following standards:
- 1. ANSI – American National Standards Institute
 - a. ANSI Z535.1 Safety Colors
 - 2. American Society of Mechanical Engineers
 - a. ANSI/ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings
 - b. ANSI/ASME B1.20.1:2013 - Pipe Threads, General Purpose (Inch)
 - 3. American Bearing Manufacturers Association:
 - a. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings
 - b. ABMA 11 - Load Ratings and Fatigue Life for Roller Bearings
 - 4. American National Standards Institute/Hydraulic Institute
 - a. ANSI/HI 9.6.4 - Rotodynamic Pumps for Vibration Analysis and Allowable Values
 - b. ANSI/HI 14.6 - Rotodynamic Pumps for Hydraulic Performance Acceptance Tests
 - c. HIC - Hydraulic Institute Test Code
 - 5. American Welding Society (AWS):
 - a. AWS D1.1 - Structural Welding Code
 - 6. AISI/SAE – American Iron and Steel Institute/Society of Automotive Engineers
 - a. AISI/SAE 316 (UNS S31600) – 316 Stainless Steel
 - b. AISI/SAE 316L (UNS S31603) – 316L Stainless Steel

7. International Standards Organization (ISO)
 - a. ISO 1940-1 - Mechanical Vibration -- Balance Quality Requirements for Rotors in a Constant (Rigid) State
 - b. ISO 2151-2004 (E) - Noise Test Code for Compressors and Vacuum Pumps

1.05 SUBMITTALS

- A. Furnish the following data with equipment submittals in accordance with Section 01 33 00, Submittal Procedures.
 1. Seismic Calculations, if requested
 2. Equipment Bases: Submit material, layout with dimensions, drill pattern, mounting hardware, and anchor data.
 3. Lifting Eyes: Show location on equipment layout drawings.
 4. Pipe Connections: Call out pipe connection standards on all equipment layout drawings.
 5. Bearings: Provide ABMA L-10 bearing life for all equipment bearings. Show bearing lubrication location and detail on equipment drawings.
 6. V-belt Drives: Provide calculation of service factor, number of belts. Show belt, sheave, and guard arrangement on equipment drawings.
 7. Drive Shaft Couplings: Provide service life, product information. Show coupling and guard arrangement on equipment drawings.
 8. Nameplates: Submit material, layout with dimensions, and data.
 9. Finishes: Provide coating data sheet for all factory applied coatings.
 10. Noise Attenuation: Provide noise attenuation data, if requested. If enclosure is required, provide product data and details for enclosure.
 11. Delivery: Submit bill of materials or shipping manifest prior to or upon delivery of products to point of destination.

2.00 PRODUCTS

2.01 GENERAL

- A. All equipment is to be designed for the service intended, of rugged construction, of ample strength for all stresses, which may occur during fabrication, transportation, erection and during continuous or intermittent operation.
- B. Seismic: All equipment is to be design for the project seismic zone. Calculations demonstrating this requirement shall be furnished to the Engineer if requested.

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- C. Where product specifications include a named manufacturer, with or without model number, and also include performance requirements, named manufacturer's products must meet the performance specifications.
- D. Unless otherwise specified, equipment or material of the same type or classification used for the same purpose shall be the product of the same manufacturer and shall be the same model.
- E. Mechanical and electrical equipment, particularly bearings, contacts and other wearing parts shall be designed for extended periods of operation without frequent maintenance or attention.
- F. Motors and drives shall be furnished with safety devices including shear pins, flexible coupling guards and belt guards.
- G. All machinery shall be designed such that all working parts are readily accessible for inspection and repair, and each part is suitable for the service required.
- H. Cathodically compatible materials of construction shall be used for fabrication.

2.02 STRUCTURAL STEEL

- A. Structural steel components shall meet the minimum requirements of Section 00 55 00, Metal Fabrications.
- B. Manufacture parts to U.S.A. standard sizes and gauges.
- C. Design structural members for anticipated shock and vibratory loads.
- D. Use 1/4-inch minimum thickness unless otherwise specified or approved.

2.03 EQUIPMENT METAL BASES

- A. Mount equipment assemblies on a single heavy cast iron or welded steel base unless otherwise shown or specified.
- B. The base shall comprise a base plate, perimeter flange, and reinforcements.
- C. Base plate shall be fabricated of steel not less than 1/4" thick, unless otherwise specified.
- D. Perimeter flange and reinforcements shall be designed to prevent flexing or warping under operating conditions.
- E. Base plate and/or flange shall be drilled for hardware used to secure unit base to concrete pad.
- F. Provide base plate and/or flange with machined support pads and tapered dowels for alignment or mating of adjacent items.
- G. Provide adequate openings to facilitate grouting after installation and openings for electrical conduits in base plate.
- H. Round or chamfer and grind smooth all corners.

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- I. Continuously weld seams and contact edges between steel plates and shapes AWS D1.1, and grind welds smooth.
- J. Provide jacking screws in equipment bases and bedplates to aid in leveling prior to grouting.
- K. Base shall contain provisions for lifting the complete equipment assembly during shipping and installation.
- L. All equipment bases and baseplates shall be mounted on reinforced concrete pads at least 4 inches high in accordance with Section 03 30 00 Cast-in-Place Concrete.

2.04 ANCHORS

- A. Each equipment manufacturer shall furnish an anchor bolt pattern and a schedule of the sizes of the required anchor bolts, nuts, and washers of adequate design for securing bases and bedplates to concrete bases.
- B. Provide anchor bolt design of a length to allow for 1-1/2-inch of grout under baseplates and adequate anchorage into structural concrete, unless otherwise specified.
- C. Anchor and assembly bolts and nuts shall be of ample size and strength for the purpose intended.
- D. All bolts shall be standard machine bolts, with cold pressed hexagon nuts.
- E. Provide suitable degauling compounds for bronze and stainless steel threaded components.
- F. Any space wholly or partially underground, or having a wall or ceiling forming part of a water channel, is classified as a submerged location. Bolts and nuts in submerged locations, corrosive areas, or submerged and embedded in concrete or buried in earth shall be AISI 316 stainless steel.

2.05 HARDWARE

- A. All machine bolts, nuts and cap screws shall be of the hex head type. Hardware of parts requiring special tools or wrenches shall not be used.

2.06 LIFTING EYES

- A. Supply all equipment weighing over 100 pounds with lifting eyes. Parts of equipment assemblies which are normally serviced separately, such as motors, shall have lifting eyes of their own.

2.07 MOTORS

- A. All motors, unless otherwise specified, shall comply with Motor specification section(s).

2.08 FLANGES AND PIPE THREADS

- A. Unless otherwise noted, all flanges on equipment and appurtenances provided under this section shall conform in dimensions and drilling to ASME/ANSI B16.1, Class 125.
- B. All pipe threads shall conform in dimension and limits of size ASME/ANSI B1.20.1 NPT, Taper Pipe Thread.

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C. Grooved pipe connections shall be Victaulic or Engineer approved equal.

2.09 GUARDS

A. All exposed moving parts shall be provided with guards in accordance with the requirements of the WISHA and Occupational Safety and Health Act.

B. Guards shall be fabricated of minimum 12-gauge steel and expanded metal screen to provide visual inspection of moving parts without removal of the guard.

C. The guard shall be primed with a minimum of 2.5 to 3.5 Mils of Tnemec 1 primer. Two coats of finish epoxy coating Tnemec N69 (minimum 3.0 to 5.0 Mils DFT) shall be applied in accordance with the safety color definition of ANSI Z535.1 Safety Color Code for marking physical hazards.

2.10 BEARINGS

A. Unless otherwise specified, all equipment bearings shall be oil or grease lubricated, ball or roller anti-friction type of standard manufacture.

B. Bearings shall be conservatively designed to withstand all stresses of the service specified.

C. Bearing shall be rated in accordance with the latest revisions of ABMA 9 or 11. ABMA L-10 life shall not be less than 100,000 hours for process equipment, and 50,000 hours for other equipment unless otherwise specified or approved.

D. All grease lubricated bearings, except those specified to be factory lubricated for life, shall be fitted with easily accessible grease supply, flush, drain and relief fittings. Extension tubes shall be used when necessary. Grease supply fittings shall be the standard hydraulic type.

E. Oil lubricated bearings shall be equipped with either a pressure lubricating system or a separate oil reservoir type system. Each oil lubrication system shall be of sufficient size to safely absorb the heat energy normally generated in the bearing under a maximum ambient temperature of 40 degrees C. and shall be equipped with a filler pipe and an external level gauge.

2.11 V-BELT DRIVES

A. Pulleys and bushes shall be dynamically and statically balanced. Pulleys shall be separately mounted on their bushes by means of three pull-up grub or cap tightening screws. Bushes shall be key seated to the driver shaft.

B. Belts shall be selected for not less than 150% of rated driver horsepower and, where 2 pulley sizes are specified, shall be capable of operating with either set of pulleys. Belts shall be of the anti-static type where flame-proof equipment is specified.

C. The belt tension device must be designed to allow the maintenance personnel to replace the belts without exerting or lifting over 40 pounds without the use of lifting, jacking or pulling tools.

D. Each belt-driven unit shall be furnished with a complete set of spare belts. Spare belts shall be properly identified as to design, horsepower speed, length, pulley size and use and shall be packaged and stored as specified for spare parts storage and marking. Where 2 or more belts are involved, matched sets of belts shall be provided.

2.12 SHAFT COUPLINGS

- A. General: Shaft couplings for direct connected electric motor-driven equipment 1/2 HP or larger shall be Type I or Type II as specified herein. Type I couplings shall be utilized for all reversing drives, positive displacement pumps or high torque loads. Type II couplings shall be employed on all other drives. Where requirements of the equipment dictate specialized features, the manufacturer may substitute the coupling normally supplied for the service. All couplings shall be non-lubricated type, designed for not less than 50,000 hours operating life. Coupling sizes shall be as recommended by the manufacturer for the specific application, considering horsepower, speed of rotation and type of service. The use of couplings as specified herein shall not relieve the requirement for precision alignment of all driver-driven units.
- B. Type I couplings: Positive displacement pumps and reversing equipment or equipment where sudden torque reversals may be expected shall be connected to their drivers by flexible couplings which can accommodate angular misalignment, and end float, and which cushions shock loads and dampens torsional vibrations. The flexible member shall consist of a built-up elastic member comprised of synthetic rubber, duck and wire reinforcement with synthetic tension members bonded together in rubber. The flexible member shall be attached to flanges by means of clamping rings and cap screws and the flanges shall be attached to the stub fit. There shall be no metal-to-metal contact between the driver and driven unit.
- C. Type II couplings shall be employed on normal torque, non-reversing applications. Type II couplings shall be of the pin and preloaded neoprene cylinder type, designed to accommodate shock loading, vibration and shaft misalignment or offset. Stub shafts shall be connected through collar or round flanges, firmly keyed to their shafts, to neoprene cylinders held to individual flanges by through pins. Couplings with cylinders pinned to both coupling flanges will not be acceptable.

2.13 NAMEPLATES

- A. Manufacturer's Nameplate: Furnish each piece of equipment and its driver with a corrosion-resistant metal nameplate in accordance with Section 40 05 53 unless otherwise specified.
- B. Equipment Tags: Furnish each piece of equipment with a tag in accordance with Section 40 05 53.

2.14 PROTECTION AGAINST ELECTROLYSIS

- A. Where dissimilar metals are used in conjunction with each other, provide suitable insulation between adjacent surfaces, so as to eliminate direct contact and any resultant electrolysis. Connections of dissimilar piping materials shall utilize dielectric unions, flanges, couplings, or bushings.

2.15 FINISHES

- A. Finishes shall meet the requirements of Section 00 96 00, High Performance Coatings.
- B. Factory Painting: On pumps, blowers, motors, drives, starters, control panels, and other similar self-contained or enclosed components, apply a factory protective paint system unless otherwise noted. Paint or otherwise protect surfaces that are inaccessible after assembly by a method, which provides protection for the life of the equipment.

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- C. Shop Priming: Except where field sandblasting is required, apply one or more shop coats of metal primer on surfaces to be finish painted at the site, of sufficient thickness to protect surfaces until finished. Primer shall be compatible with finish coat, Tnemec 1 or equal.
- D. Rust Preventive: Machined, polished, other ferrous surfaces, and non-ferrous surfaces, which are not to be painted shall be coated with a rust preventive compound.

2.16 NOISE AND VIBRATION

- A. Mechanical and electrical equipment, as installed in this project, shall not create sound levels that are in excess of that permitted by WISHA/OSHA for 8 hours per day worker exposure unless otherwise noted for the specific piece of equipment involved.
- B. Sound levels shall be demonstrated per ISO 2151-2004 (E) when requested by Engineer to verify equipment sound levels.
- C. If the required sound level cannot be achieved by bare equipment in its designated environment, provide sound attenuating enclosures. Sound attenuating enclosures shall have necessary ventilation to prevent equipment overheating and shall be constructed for easy removal to permit maintenance. Devices necessary for day-to-day operation shall pierce the enclosure or otherwise be accessible without need to remove the enclosure.
- D. Equipment, which when operating has obvious excessive vibrations, shall be repaired or replaced as directed by the Engineer. Baseline vibration measurements shall be made where specified.

2.17 LUBRICATION

- A. An adequate and, as far as practicable, automatic means of lubrication for all working parts shall be provided. Arrange lubrication grease nipples, grease boxes and other lubrication devices so that they are readily accessible for routine greasing.
- B. Make lubrication points that are not readily accessible, accessible by using grease nipples and Type 316 stainless steel tubing extension with plastic tubing where required for flexibility. Secure the nipples to the equipment at appropriate locations.
- C. Use grease nipples of a consistent type; alemite button head type or equivalent.
- D. A list of all required lubricants shall be provided in the operation and maintenance manuals.
- E. Provide initial lubricant recommended by equipment manufacturer in sufficient quantity to fill lubricant reservoirs and to replace consumption during testing, startup, and operation until final acceptance by Owner.

2.18 SPARE PARTS

- A. All equipment shall be furnished with spare parts as specified and as recommended by the manufacturer and all accessories required to place each item of equipment in full operation. These spare parts include, but are not limited to, adequate oil and grease (as required for first lubrication

of equipment after field testing), light bulbs, fuses, and other spare parts as required for maintenance.

B. Additional spare parts shall be furnished as specified elsewhere in the Specifications.

C. All bearings, bushings, and shaft sleeves shall be “export” packaged.

2.19 SPECIAL TOOLS

A. For each type of equipment to be furnished, provide a complete set of all special tools which may be necessary for the adjustment, operation, and maintenance of such equipment. These special tools include: grease guns or other lubricating devices, valve keys and operators, and special wrenches.

3.00 EXECUTION

3.01 FACTORY TESTS

A. Perform factory tests for each piece of equipment where specifically called for in the section specifying that equipment. Note that factory tests are inherent in many reference standards. The requirement for a factory test in a referenced standard is hereby made a part of these Specifications. Factory tests shall be included in the contract lump sum price for the particular equipment item.

B. Conduct factory tests at the same speeds and other conditions at which the equipment will operate in the field, except as noted.

C. Where specifically noted, performance tests may be witnessed by the Engineer or his representative. Inform the Engineer 30-calendar days before the test to allow arrangements to be made for witness of such tests. When non-witnessed tests are performed, supply certified results.

D. Factory testing of pumps shall be performed in accordance with the requirements and standards of the Hydraulic Institute. The pump manufacturer shall factory-test the pumps and furnish a written quality assurance record confirming the following testing procedures to the Engineer at the time of shipment. Recordings of the test shall substantiate the correct performance of the equipment at the design head, capacity, suction lift, speed and horsepower as specified. Manufacturer shall also submit certified pump curves showing compliance with specification requirements.

E. Factory testing on pumps shall include the following inspections:

1. Impeller, motor rating and electrical connections shall be checked for compliance with this specification.
2. Prior to submergence, each pump shall be run dry to establish correct rotation.
3. Each pump shall run submerged in water.
4. Motor and cable insulation shall be tested for moisture content or insulation defects.

F. Tests of other equipment shall conform to the requirements set forth in these Specifications.

3.02 PRODUCT SHIPMENT, PROTECTION AND STORAGE

- A. Contractor shall make its own provisions for properly delivering, storing, and protecting all material and equipment against theft, injury or damage from any and all causes until final acceptance. Damaged material and equipment shall not be used in the work.
- B. All goods shall be transported and handled according to manufacturer's instructions.
- C. All goods shall be assembled and match marked in the shop prior to shipment.
- D. All loose goods shall be carefully packed in strong wooden crates or plastic wrapped as appropriate and clearly marked as to its contents, manufacturer, and Seller's name. Ship complete containers or trailer mounted units with a minimal amount of loose equipment.
- E. All piping shall have ends capped off prior to dispatch and securely fastened to prevent damage during transit.
- F. All pumps, compressors and blowers shall be shipped on their individual base plates, complete with wooden shipping pieces and covers over suction and discharge except where they have been pre-piped into the system.
- G. Polished and machined metal surfaces shall be protected from corrosion and damage during shipment. All equipment shall be carefully packed and crated for shipment, especially electrical equipment as to prevent damage to insulation by moisture. Cover equipment having exposed bearings and glands to prevent intrusion of foreign matter.
- H. Provide temporary storage facilities for material and equipment. Provide heat for equipment storage as recommended by manufacturer.
- I. Any material, equipment or apparatus damaged because of improper storage or protection will be rejected and any repair or replacement will be at no cost to the Owner.

3.03 EQUIPMENT INSTALLATION

- A. All materials and equipment shall be installed in accordance with manufacturer's recommendations, unless specifically directed otherwise by the Engineer.
- B. Belt driven equipment: Mount with motors on common steel base with adjustable motor mount.
- C. Locate and install sleeves, inserts and supports as required at proper stages of construction.
- D. Install equipment so nameplates are visible.

3.04 INSTALLATION OF PUMPS

- A. Pumps shall be set level and plumb with no stresses on the suction and discharge connections.
- B. Contractor shall bolt pump bases to the concrete equipment pad with stainless steel anchor bolts and nuts unless otherwise indicated on drawings. Grout leveling pads shall be used on top of concrete pad with a minimum thickness of 1/2 inches. Nonshrink grout shall be used. Grout shall

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be neatly mitered from base and troweled smooth. All grout spatter shall be completely cleaned from all surfaces.

- C. After securing base to concrete equipment pad, Contractor shall make adjustments and corrections necessary to assure that the pump and associated equipment are in alignment.
- D. Whether shown or not, for all pumps (other than submersibles), Contractor shall provide suction and discharge rubber expansion couplings for isolating pump vibration from piping and piping movement due to temperature changes from pump, or for taking up misalignment between piping and pumps.
- E. Contractor shall verify that all piping connected to the pumps is supported from the adjacent structure without placing any load on the pumps.
- F. Contractor shall thoroughly flush and clean piping before connecting pumps to piping.
- G. Contractor shall completely fill the grout dam in the pump station base with non-shrink grout after all anchor bolts, piping and control connections are installed,
- H. Contractor shall verify adequate lubricants.
- I. Contractor shall verify proper direction of pump rotation.
- J. Contractor shall check v-belt tension and tighten as required.

3.05 START-UP PROCEDURES

A. General:

- 1. Provide material and labor required to perform start-up of each respective item of equipment and system prior to beginning of test, adjust and balance procedures. Provide information and assistance required, cooperate with test, adjust and balance services.
- 2. Comply strictly with manufacturer's specified procedures in starting up mechanical equipment.

B. Bearings:

- 1. Inspect for cleanliness, clean and remove foreign materials.
- 2. Verify alignment.
- 3. Replace defective bearings and those which run rough or noisy.
- 4. Lubricate as necessary and in accord with manufacturer's recommendations.

C. Drives:

- 1. Adjust tension in V-belt drives and adjust sheaves and drives for proper equipment speed.
- 2. Adjust drives for alignment of sheaves and V-belts.

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3. Clean, remove foreign materials before starting operation.
- D. Motors:
1. Check each motor for amperage comparison to nameplate value at full equipment load.
 2. Correct conditions which produce excessive current flow and which exist due to equipment malfunction.
 3. Check for proper rotation before running equipment.
 4. Motor testing requirements shall comply with Division 26.
- E. Pumps:
1. Check mechanical seals for cleanliness and adjustment before running pump.
 2. Inspect shaft sleeves for scoring.
 3. Inspect mechanical faces, chambers and seal rings, replace if defective.
 4. Verify that piping system is free of dirt and scale before circulating liquid through the pump.
- F. Control Valves:
1. Inspect both hand operated and automatic control valves, clean bonnets and stems.
 2. Tighten packing glands to assure no leakage, but permit valve stems to operate without galling.
 3. Replace packing in valves to retain maximum adjustment after system is judged complete.
 4. Replace packing on any valve which continues to leak.
 5. Remove and repair bonnets which leak.
 6. Coat packing gland threads and valve stems with a surface preparation of "Moly-Cote" or "Fel-Pro" after cleaning.
- G. Verify that control valve seats are free from foreign material and are properly positioned for intended service.
- H. Tighten flanges and couplings after system has been placed in operation.
1. Replace all gaskets which show any sign of leakage after tightening.
- I. Inspect screwed and welded joints for leakage.
1. Promptly remake each joint which appears to be faulty, do not wait for rust to form.

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2. Clean threads on both parts, apply compound and remake joints.
 3. Cut out welded joint and replace with new section of pipe and new couplings.
- J. After system has been placed in operation, clean strainers, dirt pockets, orifices, valve seats and headers in fluid systems to assure system is free of foreign materials.
- K. Remove rust, scale and foreign materials from equipment and renew any defaced surfaces.
- L. Inspect each pressure gauge and thermometer for calibration.
1. Replace items which are defaced, broken, or which read incorrectly.
- M. Repair damaged insulation.
- N. Vent gases trapped in any part of systems.
1. Verify that liquids are drained from all parts of gas or air systems.
- O. Check piping for leaks at every joint, and at every connection, using "Leak-Tek" or other approved compound.

*** * * END OF SECTION * * ***

1.00 GENERAL

1.01 DESCRIPTION OF WORK

- A. Flow meter(s) shall be furnished, installed, calibrated, tested, and placed into operation as specified herein and shown in the Drawings, complete.
- B. The meter(s) shall be located in the positions indicated on the Process Drawings. Electrical and instrumentation connections shall be in accordance with the Process and Instrumentation Diagrams, Electrical Drawings, and Instrumentation Drawings.

1.02 RELATED WORK

- A. Section 01 33 00 - Submittal Procedures
- B. Section 01 75 00 - Testing, Start-Up, and Training Procedures
- C. Division 22 - Plumbing
- D. Division 26 - Electrical
- E. Division 40 - Process Interconnections

1.03 SUBMITTALS

- A. Submittals on the following shall be provided to the Engineer in addition to and in accordance with Specification Section 01 33 00, Submittal Procedures:
 - 1. All the information below shall be provided for the flow sensors and transmitters.
 - 2. Manufacturer's technical data and description literature with specifications for operation and materials of construction, and electrical and instrumentation requirements.
 - 3. A complete description of transmitters and how they will be integrated with the flow meters.
 - 4. Wiring diagrams.
 - 5. Bill of materials.
 - 6. Warranty as specified herein.
 - 7. Installation instructions and details.
- B. Operating and Maintenance Manuals shall be submitted in operation and maintenance manual for Division 40 in accordance with Section 01 33 00, Submittals. The operation and maintenance manuals shall also include:
 - 1. The location of the nearest service center for maintenance and calibration.

2. Approved submittals.

1.04 BIDDING

A. Meter costs shall be included in the cost for the piping system where it is installed, as a separate item in the Schedule of Values.

1.05 WARRANTY

A. Contractor shall warrant the equipment specified herein for a period of one (1) year from the Date of Substantial Completion and in accordance with the General Conditions.

B. The manufacturer of the flow sensor and transmitter shall provide a 1-year extended warranty on these components, in addition to the warranty specified above.

2.00 PRODUCTS

2.01 MAGNETIC FLOW SENSORS

A. Manufacturer:

1. The electromagnetic flow sensors shall be:

- a. Siemens Sitrans F M MAG 3100 or 1100 Series
- b. Endress + Hauser Proline Promag 53H or 53P
- c. Engineer-approved equal.

2. All electromagnetic flow sensors and transmitters shall be furnished by a single vendor and shall be product of the same manufacturer.

B. Magnetic Flow Meter Schedule:

1. The schedule is attached to the end of this specification section.

C. Measuring Principle:

1. Electromagnetic induction

D. Process Connection:

1. Mating flanges: ANSI B 16.5 Class 150 (290 psi)

E. Rated operating conditions:

1. Ambient temperature: -40 ... +70 °C (-40 ... +158 °F)

2. Temperature of medium:

- a. Ceramic Liner: -20 ... +150 °C (-4 ... +302 °F)

- b. PFA Liner: -30 ... +130 °C (-22 ... +266 °F)
 - c. Ebonite: -10 ... +70 °C (14 ... 158 °F)
 - d. PTFE: -20 ... +130 °C (-4 ... +266 °F)
3. Operating pressure range: -0.3 to 290 psi
4. Mechanical load (vibration): 3.17 grms
- F. Enclosure Rating:
- a. IP67/NEMA 4X
- G. Materials:
1. Housing:
- a. Stainless steel AISI 316L/1.4404
 - b. Carbon steel ASTM A 105, with corrosion resistant two-component epoxy coating (min. 150 µm).
2. Electrode
- a. Platinum
 - b. Tantalum
 - c. Hastelloy C276 or C22
3. Grounding electrode
- a. Platinum
 - b. Tantalum
 - c. Hastelloy C22
 - d. Stainless Steel AISI 316/1.4436
4. Terminal box: Fibre glass reinforced polyamide
5. Fixing studs: Stainless Steel AISI 304/1.4301
6. Gaskets:
- a. Ethylene Propylene Diene Monomer (EPDM) (max. 150 °C, PN 40 (max. 302 °F, 600 psi))
 - b. Polytetrafluoroethylene (PTFE) (max. 130 °C, PN 25 (max. 266 °F, 300 psi))

7. Pipe connection adapters:
 - a. Stainless Steel (SS) AISI 316/1.4436
 - b. Hastelloy C22/2.4602
 - c. Polytetrafluoroethylene (PVDF)
8. Liner:
 - a. Ceramic (Zirconium oxide (ZrO₂) or Aluminum oxide Al₂O)
 - b. Polytetrafluoroethylene (PTFE) Teflon
 - c. Perfluoroalkoxy Copolymer Resin (PFA)
 - d. Ebonite

H. Cable Entries:

1. Remote installation 2 x M20 or 2 x ½" NPT

I. Certificates and Approvals:

1. Standard production calibration, calibration report shipped with sensor: Zero-point, 2 x 25 %, 2 x 90 %

2.02 TRANSMITTERS

A. Manufacturer:

1. The transmitters shall be:
 - a. Siemens Sitrans F M MAG 6000 Series, or
 - b. Engineer-approved equal.
2. Transmitters shall be compatible with the sensors furnished.
3. All electromagnetic flow sensors and transmitters shall be furnished by a single vendor and shall be product of the same manufacturer.

B. Mode of operation and design:

1. Measuring principle: Electromagnetic with pulsed constant field
2. Detection of empty pipe feature with cable for remote mounted installations

C. Outputs

1. Current output:

- a. Signal range: 4 to 20 mA
 - b. Load: $< 800 \Omega$
 - c. Time constant: 0.1 ... 30 s, adjustable
2. Digital output:
- a. Frequency: 0 ... 10 kHz, 50 % duty cycle (uni/bidirectional)
 - b. Pulse (active): 24 V DC, 30 mA, $1 \text{ K } \Omega \leq R_i \leq 10 \text{ K } \Omega$, short-circuit protected (power supplied from flow meter)
 - c. Pulse (passive): 3 ... 30 V DC, max. 110 mA, $200 \Omega \leq R_i \leq 10 \text{ K } \Omega$ (powered from connected equipment)
 - d. Time constant: 0.1 ... 30 s, adjustable
- D. Features and Performance:
1. Low flow cut off: 0 ... 9.9 % of maximum flow
 2. Galvanic isolation: All inputs and outputs are galvanically isolated.
 3. Max. measuring error (incl. sensor and zero point): 0.2 % ± 1 mm/s.
- E. Rated operation conditions:
1. Ambient temperature for Operation: -20 ... +60 °C (-4 ... +140 °F)
 2. Mechanical load (vibration): 3.17 grms
- F. Enclosure Rating:
1. IP67/NEMA 4X
- G. Display and keypad:
1. Totalizer: Two eight-digit counters for forward, net or reverse flow
 2. Display: Background illumination with alphanumeric text, 3 x 20 characters to indicate flow rate, totalized values, settings and faults; Reverse flow indicated by negative sign.
 3. Time constant: Time constant as current output time constant.
- H. Enclosure material: Fiber glass reinforced polyamide.
- I. Power Supply: 115 ... 230 V AC +10 % -15 %, 60 Hz.
- J. Certificates and approvals: UL general purpose, FM Class I, Div 2 (if required for application)

2.03 SPECIAL TOOLS AND SPARE PARTS

- A. Manufacturer shall furnish one (1) set of standard spare parts.

3.00 EXECUTION

3.01 INSTALLATION

- A. Contractor shall install the equipment specified herein in accordance with the Manufacturer's recommendations and as shown on the Drawings.
- B. The flow sensors shall be provided with nameplates and tags as specified in Section 40 05 53 - Identification for Piping and Equipment.
- C. Manufacturer's representative provide services during installation, inspect the installation, and provide a Certification of Installation as specified in Specification Section 01 75 00, Testing, Start-Up, and Training.

3.02 TESTING

- A. Factory Test. Certified copies of the calibration certificates shall be provided for each flow meter to the Engineer prior to shipment in accordance with Section 01 33 00, Submittals
- B. On-site testing shall comply with the requirements of Section 01 75 00, Equipment Testing and Start-Up.
- C. Manufacturer's qualified service representative shall certify the installation and on-site testing in accordance with Section 01 75 00, Testing, Start-Up, and Training.
- D. Manufacturer's qualified service representative shall provide a minimum of eight (8) hours of on-site testing the sensors and transmitters.

3.03 TRAINING

- A. Manufacturer's qualified service representative shall provide a minimum of four (4) hours of training of the Owner's staff for operation and maintenance of the flow sensors and transmitters.
- B. Training shall meet the requirements of Section 01 75 00, Testing, Start-Up, and Training.

3.04 11-MONTH SERVICE

- A. Eight (8) hours of service for recalibration, operational check of all system components shall be provided 11 months following the Date of Substantial Completion. Time of this additional service shall be coordinated with the Owner's staff. Cost for 11-month service shall be included in the bid cost for the work specified in this section.

Table 40 71 13. Magnetic Flow Meter Schedule

Meter No. (1)	PID No. (2)	System (1)	Specified Flow Range	Nominal Pipe Diameter	Housing Material (3)	Gasket Material	Liner Material	Electrode Material	NEC Class 1, Div 2 Rating	Grounding Electrode Required (4)	Transmitter Mounting
M-LS-FF-1		FF	0 – 2,000 GPM	8”	CS	N/A	PTFE	Hastelloy C	No	Built-In	Local, elevated to within 1’-0” of access hatch
M-D-WAS-1		WAS	0 – 600 GPM	4”	CS	N/A	PTFE	Hastelloy C	No	Built-In	Local
M-MLSS-1		MLSS	0 – 2,000 GPM	10”	CS	N/A	PTFE	Hastelloy C	No	Built-In	Local

Footnotes:

1. Refer to Drawings for location and piping system codes.
 - a. FF = Filter Feed
 - b. WAS = Waste Activated Sludge
 - c. MLSS = Mixed Liquor
2. Refer to Drawing I Drawings for tag numbers.
3. Epoxy-Coated Carbon Steel (CS).
4. Grounding electrodes are the same material as measuring electrodes.

*** END OF SECTION ***

1.00 GENERAL

1.01 DESCRIPTION OF WORK

- A. Turbidity process measurement devices shall be furnished, installed, calibrated, tested, and placed into operation as specified herein and shown in the Drawings, complete.
- B. The turbidimeters shall be located in the positions indicated on the Process Drawings. Electrical and instrumentation connections shall be in accordance with the Process and Instrumentation Diagrams, Electrical Drawings, and Instrumentation Drawings.

1.02 RELATED WORK

- A. Section 01 33 00 - Submittal Procedures
- B. Section 01 75 00 - Testing, Start-Up, and Training Procedures
- C. Division 26 - Electrical
- D. Division 40 - Process Interconnections

1.03 SUBMITTALS

- A. Submittals on the following shall be provided to the Engineer in addition to and in accordance with Specification Section 01 33 00, Submittal Procedures:
 - 1. Manufacturer's technical data sheet.
 - 2. Wiring diagram.
 - 3. Bill of materials.
 - 4. Warranty as specified herein.
 - 5. Installation instructions and details.
- B. Operating and Maintenance Manuals shall be submitted in operation and maintenance manual for Division 40 in accordance with Section 01 33 00, Submittals. The operation and maintenance manuals shall also include:
 - 1. Approved submittals.

1.04 BIDDING

- A. Costs for equipment specified in this Section shall be included in the cost for the Instrumentation and Control, as a separate item in the Schedule of Values.

1.05 WARRANTY

- A. Contractor shall warrant the equipment specified herein for a period of one (1) year from the Date of Substantial Completion and in accordance with the General Conditions.
- B. Contractor shall furnish manufacturer's standard two (2) year warranty.

2.00 PRODUCTS

2.01 TURBIDIMETERS

A. Manufacturer

- 1. Hach Company, Loveland, CO Model 1720E Turbidimeter, or
- 2. Engineer-approved equal.

B. Measurement Procedures

- 1. The method of measuring turbidity will nephelometric.
 - a. Incandescent light will be directed into the sample stream in the turbidimeter body.
 - b. The light scattered at 90 degrees will be sensed by a submerged photocell in the measuring chamber.
- 2. The method will meet or exceed instrument design criteria set by USEPA method 180.1 and Standard Methods 2130B.

C. Performance Requirements

- 1. Measurement range: 0.001 to 100 Nephelometric Turbidity Units (NTU).
- 2. Accuracy
 - a. ± 2 percent of reading or ± 0.020 NTU (whichever is greater) from 0 to 10 NTU
 - b. ± 5 percent of reading from 10 to 40 NTU
 - c. ± 10 percent of reading from 40 to 100 NTU
- 3. Minimum detection limit: 0.001 NTU
- 4. Resolution
 - a. 0.0001 NTU up to 9.9999 NTU
 - b. 0.001 NTU from 10.000 to 99.999 NTU
- 5. Repeatability: $\pm 1.0\%$ of reading or ± 0.002 NTU, whichever is greater

D. Operational Criteria

1. Sample flow rate: 200 to 650 mL/minute
2. Sample temperature: 0 to 50 degrees C
3. Operating temperature: 0 to 40 degrees C
4. Operating humidity: 5 to 95 percent non-condensing
5. Continuous operation
6. The sample stream flows through an internal bubble trap.

E. Manufactured Unit

1. Turbidimeter components: incandescent light source, photocell, and bubble trap.
2. Housing: NEMA 4X/IP66 enclosure made of corrosion-resistant polystyrene.
3. The optical components are mounted in a sealed, removable head assembly.

F. Power Supply: 100 to 230 volt selectable AC power.

G. Standard equipment:

- a. Turbidimeter sensor head
- b. Turbidimeter body
- c. Manual

H. Connectors

1. Sample inlet fitting: 0.25-inch NPT female, 0.25-inch compression fitting
2. Drain fitting: 0.5-inch NPT female, 0.5-inch hose barb

I. Accessories

1. Calibration/verification module (Model ICE-PIC for 1720E)
2. StablCal® verification standards
3. Formazin calibration kit for user-prepared calibration
4. Floor stand
5. Bubble Trap

2.02 CONTROLLER

A. Manufacturer

1. Hach Company, Loveland, CO Model sc200 Controller, or
 2. Engineer-approved equal.
- B. Measurement Procedures
1. Microprocessor-based sensor controller.
 2. Digital sensors connected to the controller can be changed by unplugging and plugging in sensors as necessary.
 3. Analog sensor modules connected to the controller can be changed by unplugging and plugging analog sensor modules as necessary.
- C. The controller accepts 4 different analog sensor modules in any combination to measure the following:
1. pH/ORP module
 2. Conductivity module
 3. Dissolved Oxygen/Oxygen Scavengers module
 4. Analog mA IN module
- D. Operational Criteria
1. Temperature: -4.0 to 140.0 °F (-20.0 to 60.0 °C)
 2. Relative humidity: 0 to 95%, non-condensing
- E. Features:
1. Menu-driven operation system.
 2. Display is graphic dot matrix LCD with LED backlighting.
 3. Real-time clock.
 4. Two security levels.
 5. Data logger with RS-232 capability.
 6. Worded operation menus.
 7. SD card reader for data download and controller software upload.
 8. All user settings of the controller are retained for 10 years in flash memory.
 9. The controller is equipped with a system check for:

- a. Power up test (monitoring and shutdown)
 - b. Total power draw
 - c. Memory devices
 - d. Temperature mother board
- F. Power Supply: 100 to 240 Vac \pm 10%, 50/60 Hz; 15 W with 7 W sensor/network card load, 37 W with 25 W sensor/network card load.
- G. Outputs:
- 1. Four electromechanical, UL rated, SPDT relays (Form C) are provided for user-configurable contacts rated 100 to 230 Vac, 5 Amp at 30 VDC resistive maximum.
 - 2. Two analog 0/4-20 mA outputs are provided with a maximum impedance of 500 ohms.
 - 3. The controller can be equipped with three additional 4-20 mA outputs with a maximum impedance of 500 ohms.
- H. Materials
- 1. Housing: polycarbonate, aluminum (powder coated), and stainless steel
 - 2. Rating: NEMA 4X enclosure, rated IP66
- I. Conduit openings: 0.5 in. NPT
- J. Standard equipment
- 1. Controller
 - 2. Mounting hardware for wall, pipe, and panel mounting
- K. Accessories
- 1. Additional mA output card

3.00 EXECUTION

3.01 INSTALLATION

- A. Contractor shall install the equipment specified herein in accordance with the Manufacturer's recommendations and as shown on the Drawings.
- B. Sensors and bubble trap are to be installed on wall-mount brackets as shown on manufacture's installation instructions at the locations shown on the Drawings.
- C. Contractor shall plumb turbidimeters so that units drain to nearest building floor drain.

- D. Contractor shall install pressure regulating valve and isolation valve in the upstream piping of each turbidimeter at the point of connection to process stream as shown on the process and instrumentation diagrams.
- E. The devices shall be provided with nameplates and tags as specified in Section 22 05 53 - Identification for Piping and Equipment.
- F. Manufacturer's representative provide services during installation, inspect the installation, and provide a Certification of Installation as specified in Specification Section 01 75 00, Testing, Start-Up, and Training.

3.02 TESTING

- A. Factory Test. Certified copies of the calibration certificates shall be provided for each device to the Engineer prior to shipment in accordance with Section 01 33 00, Submittals
- B. On-site testing shall comply with the requirements of Section 01 75 00, Equipment Testing and Start-Up.
- C. Manufacturer's qualified service representative shall certify the installation and on-site testing in accordance with Section 01 75 00, Testing, Start-Up, and Training.
- D. Manufacturer's qualified service representative shall provide a minimum of four (4) hours of on-site testing.

3.03 TRAINING

- A. Manufacturer's qualified service representative shall provide a minimum of two (2) hours of training of the Owner's staff for operation and maintenance of the devices.
- B. Training shall meet the requirements of Section 01 75 00, Testing, Start-Up, and Training.

*** END OF SECTION ***

1.00 GENERAL

1.01 SUMMARY

- A. The work in this Section consists of designing, furnishing, and installing a screenings shaftless conveyor/compactor and all associated appurtenances, accessories, electrical and controls for use and incorporation into the perforated plate filter screen system. Each conveyor/compactor shall consist of a shaftless spiral screw, trough, inlet chute(s), compaction unit, drive system, support legs, covers, and electrical controls, and all other appurtenances required for a complete and operational system. Equipment shall be installed at the location shown on the Drawings and as specified herein, as recommended by the supplier and in compliance with all local, state and federal codes and regulations.
- B. Special provisions, requirements and/or revisions to this Specification and/or Bid Item(s) may be included in Section 01 01 00 (green pages) and/or on the Drawings or Details.
- C. Electrical and control components shall be in conformance with Division 26 of these contract documents.

1.03 REFERENCES

- A. The SPECO Shaftless Conveyor/Compactor shall, as applicable meet the requirements of the following industry standards:
 - 1. AISI (American Iron and Steel Institute)
 - 2. ANSI (American National Standards Institute)
 - 3. ABMA (American Bearing Manufacturers Association)
 - 4. AGMA (American Gear Manufacturers Association)
 - 5. NEMA (National Electrical Manufacturer's Association)
 - 6. NFPA (National Fire Protection Association)
 - 7. ASTM (American Society for Testing and Materials)
 - 8. WSC (American Welding Society Code)
 - 9. ASME (American Society of Mechanical Engineers)
 - 10. NEC (National Electrical Code)
 - 11. UL (Underwriters Laboratory Standards)
 - 12. IEEE (Institute of Electrical and Electronics Engineers, Inc.)
 - 13. AWS (American Welding Society) and D1.1, Structural Welding Code.
 - 14. NEC (National Electric Code)
 - 15. NEMA (National Electrical Manufacturers Association)
 - 16. CEMA (Conveyor Equipment Manufacturers Association)
 - 17. OSHA (Occupational Safety Health Administration)

1.02 MANUFACTURER

- A. The hydraulic screenings flume equipment manufacturer shall be as recommended by the manufacturer of the perforated plate filter screen.

- B. Equipment shall be designed/sized/selected by the manufacturer for this specific installation meeting the performance requirements herein. Shaftless spiral conveyor/compactor shall be Enviro-Care Company SPECO Shaftless Conveyor/Compactor Model CPS200, or approved equal. Approval of an alternate shall follow process outlined in Article 11 of the Instructions to Bidders.

1.04 SUBMITTALS

- A. Submittals shall conform to Section 01 33 00 of these Specifications, and shall include complete manufacturer's literature, drawings, installation instructions, operation and maintenance manuals and written warranties for all pieces of equipment and accessories.
- B. Submittals shall include:
 - 1. Certified general arrangement drawings showing all important details including materials of construction, dimensions, loads on supporting structures, and anchor bolt locations. Arrangement shall show as-built dimensions (see as-built requirements herein).
 - 2. Shop drawings, catalog cut sheets, and other materials required to completely describe and specify the system and equipment.
 - 3. A list of all deviations from drawings and specifications.
 - 4. Descriptive literature, bulletins and/or catalogs of the equipment.
 - 5. Complete data on motors and gear reducers.
 - 6. Wiring diagrams and electrical schematics for all control equipment to be furnished.

1.06 WARRANTY

- A. Warranty for the perforated plate filter screen system and all associated equipment and appurtenances shall extend for 12 months after start-up.
- B. Warranty shall include all parts, labor, shipping, and coatings for repairing or replacing equipment that fails during the warranty period. Defects occurring within the warranty period shall be repaired or replaced by the manufacturer at no cost to the Owner.

1.07 PRECONSTRUCTION AS-BUILT

Prior to construction Contractor shall obtain and provide to the manufacturer as-built information required for manufacturer design/selection/supply of the equipment and appurtenances specified herein to be installed at the location shown on the Drawings. Equipment shall be manufactured to accommodate existing conditions and for installation as shown, and shall include all required appurtenances, anchors, connections, and any other needed item for a complete and operational system sized for this specific installation and installed at the location shown in the Drawings. Any modifications required to existing structures, building, or other existing features shall be included in the amount bid.

1.08 DELIVERY, STORAGE AND HANDLING:

Items to be shipped as complete assemblies except where partial disassembly is required by transportation regulations or for protection of components. Equipment shall be delivered as completely assembled as practical to minimize field assembly. All equipment be pre-piped and pre-wired at the factory as much as practical. Contractor shall be responsible for unloading and any necessary field assembly. Contractor shall contact manufacturer for assembly requirements during bid.

1.09 SEQUENCING AND SCHEDULING:

Coordinate work with restrictions as specified in the Contract Documents. Perforated Plate Filter Screen system including hydraulic screenings flume sequencing will require temporary bypass structures in the headworks channel which shall be included in the amount bid. See Section 01 01 00 Special Requirements and Section 01 89 00 Sequence and Limitations of Construction.

2.00 PRODUCTS

2.01 QUALITY ASSURANCE

- A. Equipment manufacturer shall be ISO 9001 certified.
- B. The SPECO Shaftless Conveyor/Compactor will be shipped to the site fully assembled, if possible, and dependent upon the length of the conveyor. Some ancillary components may be removed to prevent damage during shipment.

2.02 PERFORMANCE REQUIREMENTS

Conditions	Unit
Number of screens	Qty (1)
Influent Type	Municipal Screenings
Inlet Solids Capacity (CFH)	70
Angle of Inclination	20 degrees
Trough Length (ft)	11.5
Configuration	Push
Number of Inlets	One (1)
Number of Outlets	One (1)

2.03 UTILITY REQUIREMENTS/ENVIRONMENTAL CONDITIONS

Conditions	Unit
Spray Wash Water (gpm/psi)	8 gpm @ 40 – 60 psi
Power Supply (V/P/Hz)	460/3/60
Compactor Installation Location (indoor/outdoor)	Indoor
Compactor NFPA Classification Requirement	Class I, Div. 1
Control Panel Location (indoor/outdoor)	Indoor
Control Panel NFPA Classification Requirement	Class I, Div. 1

2.04 DESIGN REQUIREMENTS

- A. Materials: The materials used in the fabrication of the spiral conveyor furnished under this section shall conform to the following:

Trough	2 mm thick 316 stainless steel
Spiral	Micro Alloy steel: OD of 7.0 inches; Minimum thickness of 0.79 inch and depth of 2.3 inch
Wear Liners	8 mm thick UHMW-PE

SHAFTLESS SPIRAL CONVEYOR/COMPACTOR

Covers	316 stainless steel
Compaction Zone	316 stainless steel
Back Pressure Iris	SINT® engineered polymer
Inlet Hoppers and Discharge Chutes)	316 stainless steel
Support Legs	316 stainless steel
Bolts, nuts and washers	316 stainless steel
Anchors	316 stainless steel

B. General

1. Shall be designed/selected by the manufacturer for this specific installation meeting the performance criteria herein, and as required for perforated plate filter screen to meet the performance requirements.
2. Functional Description: The conveyor will accept solids with a dry weight not less than 8% solids at the screenings inlet. The shaftless spiral will convey the solids to the dewatering zone. Solids are then pushed through the dewatering zone to discharge and pressate liquid is directed to the drain.
3. Refer to and comply with the design performance requirements list in Paragraph 2.05.
4. Shop Surface Preparation/Coating: All welds shall be cleaned and passivated to remove weld spatter, slag and discoloration using glass bead blasting process. Bearings, electrical devices, motor and gear reducer shall be provided with the manufacturer's standard coating system.

C. Trough Assembly

1. The trough assembly shall consist of a U-trough, wear liner, inlet area, and trough cover.
2. The U-trough shall be constructed from material per Paragraph 2.05.
3. The wear liner will support the spiral throughout the trough length and be constructed of 0.32-inch thick UHMW-PE. Wear liners shall be provided in 4 foot maximum lengths and held in place by the top sections of the U-trough (no clips required).
4. Hold-down angles (when required) from 316 stainless steel shall be provided on both sides of the trough assembly to control excessive vertical movement of the spiral flights. Holddowns shall not interrupt material transportation.
5. The screenings inlet area to mate up with screen discharge chute. Inlet hopper shall have a minimum incline of 60 degrees from horizontal.
6. Except for the inlet area, the trough will be supplied with covers. Trough covers will be provided with neoprene gaskets and constructed from minimum 1 mm thick type 316 stainless steel and bolted to the flanges of the U-trough.

D. Shaftless Spiral Screw

1. The Shaftless spiral screw constructed from high strength alloy with protective primer coating. The spiral has an OD of 7.0 inches with nominal spiral cross section of 2.3 inches high x 0.79 inches thick.
2. Spiral flights shall have full penetration welds at all splice connections. Spiral flights shall be welded to a pipe with flanged disc end for connection to the end drive shaft.

E. Inlet Hopper

1. The inlet hopper shall be designed to accept discharge screenings from the screen discharge chute. The hopper shall directly interface with the filter screen discharge with no solids or water bypass.
2. The inlet hopper shall be fabricated from minimum 12-gauge type 316 stainless steel.

F. Drive Assembly

1. Gear reducer shall be a helical gear type with hollow input shaft. The unit will be provided with a cast iron frame and be designed in accordance with AGMA recommendations based on the horsepower required to operate the conveyor.
2. The motor shall be TEFC-XP (Class I, Division 1, Group D), 2.0 HP, 460 Volt, 3 phase, 60 Hz. The motor shall be NEMA design code B and be direct coupled to the reducer.

G. Dewatering Zone: The dewatering zone shall consist of a dewatering cylinder, spray system and enclosure.

1. The dewatering cylinder shall be constructed of type 316 stainless steel with 3 mm perforated openings. The dewatering cylinder shall extend the entire length of the dewatering zone.
2. Spray system will rinse the basket of expressed solids and flush the solids to the drain. Connection to the spray system shall be through a ½” NPT pipe. Spray flush requires washwater as indicated in Paragraph 2.04.
3. The dewatering zone enclosure will encapsulate the dewatering cylinder and the spray system. The enclosure will direct pressate and spray water through a 3 inch OD plain end pipe drain.
4. The cover over the dewatering zone is locked in place with a keyed latch. Cover fitted with handles to facilitate removal to allow inspection. Cover shall extend over the entire length of the dewatering zone.
5. Discharge back pressure controlled by an iris plate from SINT® engineered polymer. The back pressure iris shall control the screenings dewatering and formed plug at the discharge end.

2.05 ELECTRICAL CONTROLS AND DEVICES

- A. Electrical: In addition to the drive motor, the equipment supplier shall furnish all electrical items specifically called for in this specification section. The contractor shall supply all other electrical items, and interconnecting wiring of proper size, including all conduit and supports required to place the equipment into service.
 - 1. The following control components will be added to the screen control panel to provide proper operation of the conveyor/compactor unit:
 - a. Branch circuit protection.
 - b. Drive motor starter (IEC).
 - c. HOA switch.
 - d. Hour meter for motor.
 - e. Run indicating light.

2.06 OPERATION, MONITORING, AND CONTROL

- A. Hand Operation: When the shaftless conveyor/compactor selector switch is in the Hand position, the conveyor/compactor spiral will run continuously. Turning the shaftless conveyor/compactor selector switch to Off will stop the unit.
- B. Automatic Operation: When the shaftless conveyor/compactor selector switch is in the Auto position, the spiral will cycle on and off on demand from a remote contact closure from the screen control panel system. An off delay timer shall control the end of the conveyor/compactor r operational sequence.
- C. EMERGENCY STOP: The unit can be deactivated at any time by pressing either the control panel mounted or unit mounted Emergency Stop push buttons.
- D. FAULT CONDITIONS: Motor overload condition will stop the motor and illuminate the fault light.

2.07 ANCHORAGE AND FASTENERS

- A. Anchor Bolts: All anchor bolts shall be a minimum of 1/2 inch diameter and made of type 316 stainless steel. The equipment supplier shall furnish all anchor bolts, nuts, and washers required for the equipment.
- B. Fasteners: All fasteners shall be type 316 stainless steel. The equipment supplier shall furnish all fasteners required for the assembly of the equipment.

3.00 EXECUTION

3.01 PREPARATION

- A. The mounting points TOC shall be level and parallel and of proper size.
- B. Contractor shall verify all dimension in the field to ensure compliance of equipment dimensions with the drawings.

3.02 INSTALLATION

- A. Installation shall be in strict accordance with the Manufacturer's recommendations and instructions and shall be in accordance with the specifications herein and the Drawings. Installation shall include all equipment, labor, materials, connections, or any other item needed for a complete and operational perforated plate filter screen.
 - B. All equipment, components, piping and appurtenances shall be installed true to alignment and rigidly supported. Any damage caused by the negligence of the Contractor to the above items shall be repaired or replaced by the Contractor to its original condition.
 - C. Interconnecting piping supplied by the Contractor to be hydrostatically tested by the Contractor.
 - D. The screen system Manufacturer's representative to be present during placement and connection of the unit to instruct and observe installation.
 - E. Manufacturer's representative to inspect the installation prior to startup in order to verify that the equipment has been properly installed.
 - F. Manufacturer's representative shall calibrate the equipment with the Owner's operator present after installation prior to startup.
 - G. All products, accessories, and appurtenances shall be installed in accordance with manufacturer's instructions and approved submittals.
 - H. The Contractor shall provide all hardware and accessories required for installation.
 - I. Anchor bolts and all needed connectors are to be sized by Manufacturer and provided by Contractor.
- 3.03 START UP/TRAINING/FIELD QUALITY CONTROL**
- A. Manufacturer shall provide installation instruction manuals for Contractor's assistance at least 30 days prior to shipment of factory assembled treatment units
 - B. Manufacturer shall provide assistance regarding handling, assembly and installation requirements for complete installation by the Contractor.
- 0.1** Manufacturer shall provide assistance as needed for construction of the perforated plate filter screen system.

SHAFTLESS SPIRAL CONVEYOR/COMPACTOR

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- C. Contractor shall verify all equipment is installed in accordance with the manufacturer's recommendations and literature and the Drawings.

**** End of Section ****

1.00 GENERAL

1.01 DESCRIPTION

- A. This section covers pumping equipment as shown on the Drawings and as listed under Pump Schedule.
- B. Definitions: Terminology pertaining to pumping unit performance and construction shall conform to the ratings and nomenclature of the Hydraulic Institute Standards. Pump heads that are specified do not include pump losses, which shall be added to the values given.
- C. The Contractor shall provide two (2) mixed liquor recycle pumps and motor. One pumps shall be delivered to the City as an un-installed spare. Contractor shall provide and installs discharge elbow, sliding guide brackets, discharge flanges, access frames and guides, junction boxes, lights, controls, liquid level sensors, testing and all appurtenances as herein described and as shown on the Drawings.
- D. Pump motors shall be rated for inverter duty, and pump shall be controlled by VFD drive, as specified.

1.02 QUALITY ASSURANCE

- A. Manufacturer shall furnish all services required for provision of equipment, installation and startup.
- B. Manufacturer shall check installation and certify in writing that the installation is satisfactory.
- C. Codes and standards:
 - 1. American Water Works Association (AWWA)
 - 2. American National Standards Institute (ANSI)
 - 3. American Society of Testing and Materials (ASTM)
 - 4. National Fire Protection Association (NFPA)
 - 5. National Electrical Code (NEC)
 - 6. Hydraulic Institute

1.03 SUBMITTALS

- A. In accordance with the requirements of Section 01 33 00, submit the following project data for each pump group specified herein:
 - 1. Manufacturer's type designation and descriptive literature.
 - 2. Catalog data with pump performance curve confirming rated capacity, speed, horsepower, efficiency and electrical requirements.
 - 3. Drawings of pump assembly showing all pertinent dimensions and applicable appurtenances. Drawings of all units used in the pump assembly including materials of construction.
 - 4. All optional equipment or accessories specified with each piece of

5. A list of all recommended spare parts.

1.04 **GUARANTEES**

- A. The pump manufacturer shall warrant the units being supplied to the Owner against defects in workmanship and materials for a period of two (2) years for the pump and a period of two (2) years for the motor under normal use, operation and service. The Contractor is charged with responsibility of honoring this warranty.
- B. The pump manufacturer shall demonstrate that a parts and service center is located within 400 miles of the project location and that pump repair and reinstallation can be completed within a 48-hour turn-around period.

1.05 **PRODUCT HANDLING**

- A. Use all means necessary to protect the equipment of this section before, during, and after installation and to protect the installed work and materials of all other trades.
- B. The Contractor shall provide and use proper implements, tools and facilities for the safe and proper handling and protection of the material.
- C. In the event of damage, immediately make all repairs and replacements necessary to the approval of the Engineer and at no additional cost to the Owner.
- D. When damaged equipment cannot be repaired to the satisfaction of the Engineer, it shall be removed from the job.
- E. Equipment shall be stored in safe location, protected from the elements where damage therefrom could result.

1.06 **OPERATION AND MAINTENANCE MANUALS**

- A. Provide Operation and Maintenance manuals with detailed parts lists and local supplier in accordance with Section 01 33 00.

1.07 **ACCEPTABLE MANUFACTURER:**

- A. KSB submersible pump as represented by APSCO, LLC, Redmond, WA. Or approved equal. To be considered "or-equal", in addition to meeting all aspects of the specifications herein, the pump curve and operating characteristics shall substantially match those of the KSB model KRT D 200-315/186XEG-S IE3 for this specific application, including pump rotational speeds for given volumetric flow rates.

2.00 PRODUCTS

2.01 **GENERAL PUMPING SYSTEM REQUIREMENTS**

- A. General: General requirements for pumps and other components are provided hereafter. Specific requirements for the Mixed Liquor Recycle Pump is detailed separately under the specific pump paragraph.

- B. Seal Water: All pumps shall be capable of continuous operation without seal water.
- C. Casing Connections: Suction and discharge connections shall be ANSI 125-pound flat face flanges. All flange bolt holes shall be slotted for ease of assembly and disassembly. Unless otherwise stated, each suction and discharge piping spool shall be drilled and tipped with 1/2-inch IPS hole for gauge connections.
- D. Impeller: Impeller on all centrifugal type pumps shall be statically and hydraulically balanced. Impeller shall be keyed and secured to the shaft by a stainless steel capscrew and washer, and shall be readily removable without the use of special tools.
- E. Data Plates: All pumps shall have data plates and data plates shall be of stainless steel suitably attached to the pumps. Data plates shall contain the manufacturer's name, pump size and type, serial number, speed, impeller diameter, capacity and head rating, and other pertinent data. A special data plate shall be attached to the pump frame, which shall contain identification of frame and bearing numbers. Location of all data plates shall be easily visible in the completed installation. Contractor shall coordinate location of data plates with equipment suppliers.
- F. Hardware: All machine bolts, nuts, and capscrews shall be of the hex head type. Hardware or parts requiring special tools or wrenches shall not be used.
- G. Baseplate: Unless otherwise noted, each motor or gear motor and pump shall be mounted on a common base plate by the pump manufacturer and shipped as one unit. Baseplate shall be cast iron or FRP drip lip type, sufficiently rigid to support the pump and motor in proper alignment. A 1-inch tapped hole shall be provided near the pump end for draining to the equipment drain.
- H. Coupling: Coupling shall be of the flexible type unless otherwise specified and conform to the requirements of Section 11000. Coupling hubs shall be secured to the driver and driven shafts by a setscrew located over the key. All pumps shall be provided with an OSHA approved coupling guard.
- I. Motors: Electric motors shall be selected in accordance with the pump performance characteristics. The Motor shall comply with requirements of Section 16150 and shall be TEFC unless otherwise specified. Motor shall be inverter duty with factory installed shaft grounding rings.
- J. Motor Base: Where pumps are specified for mounting directly to motors, the motor shall be provided with a cast iron base (unless otherwise specified) of adequate height to permit access to the couplings between the motor and pump shafts from the motor floor. The motor mounting surface shall be designed for standard NEMA "P" flange motor.
- K. Direct-coupled Motor: Pump, where specified, shall be provided with a motor support adapter of sufficient size and strength to support the largest driving motor required by the pump. The motor mounting surface shall be designed for standard NEMA "P" flange motor. The motor support adapter shall bolt directly to the pump frame, and shall be designed to permit access to the frame and flexible coupling.
- L. Vibration: Centrifugal pumps shall not exceed the acceptable vibration limits in accordance with the Hydraulic Institute Standards.

- M. Expansion Joints: Shall be used on all pump connections, except submersible and unless otherwise specified.

2.02 PUMP SCHEDULE

- A. Provide pumps as specified herein and shown on the drawings in accordance with the following schedule:

PUMP SCHEDULE

Equip Nos.	Pump Type/ Location/Designation	No. Units	Flow (gpm)	Design TDH (ft)	Spec Paragraph
P- ML 1 & 2	Immersion Pumps Mixed Liquor Recirculation Pump Station 12	2	1,750	12.5	2.03

2.03 IMMERSIBLE PUMPS

- A. General:

- 1. Mixed Liquor Recirculation Pumps (Equipment Nos. P-ML-1 & P-ML-2) shall be KSB Screw Centrifugal impeller pumps, model KRT D 200-315, with immersion 20 HP (Minimum) motors complete with quick disconnect (fast out) for mounting in bottom of wet well, brackets for guide rails mounts at top of manhole, lift chain, cable and appurtenances for a complete installation.

- B. Design

- 1. The design shall be a single-passage, non-clog pump with a screw-centrifugal impeller, minimum 65% efficiency at design rating.
- 2. The leading edge of the impeller vane shall blend into the impeller body so fibrous material shall not be caught on the leading of the impeller. The impeller flange or impeller shall contain a spiral groove on the rear face for discharge of solids from the space between the backplate and the rear of the impeller.
- 3. The geometry of the impeller and suction piece shall be conical, so any axial adjustment of the impeller will cause the clearance between the impeller vane and suction piece to change uniformly along the entire length of the impeller.
- 4. Suction and discharge flanges shall be drilled to meet ANSI 125 lb. bolting.
- 5. Sealing. All mating surfaces in pump casing and in motor housing shall be machined and fitted with nitrile O-rings for watertight seal.

- C. Cast Iron Construction:

- 1. The pump volute, backplate, and suction piece shall be of closed-grained cast iron, ASTM A 48-CL30.

2. The impeller shall be of nodular iron, ASTM A 536-60-06, and shall be both statically and dynamically balanced.
3. The suction piece or impeller shall be externally adjustable to compensate for wear by means of shims or regulating screws so that the necessary running clearances between the liner and impeller can be maintained for optimum hydraulic efficiency.

D. Immersible Motor:

1. Motors shall be of the explosion-proof design, approved by Factory Mutual for uses in Class I, Groups C&D, hazardous locations. Motors shall be 480 volt, 3 phase, 60 cycle.
2. The motors shall be of the immersible type, suitable for full-load, continuous operation either completely dry or fully submerged in the pumped liquid of up to 65 foot depths. Motors shall be of the "air-filled" type, to optimize efficiency, with stator and rotor housed in a watertight chamber containing only air. Motors that circulate the pumped media through internal cooling media channels, ports, or jackets are not acceptable.
3. Motors shall incorporate a separate heat-exchanger circuit, with a shaft mounted cooling pump circulating oil from a jacket surrounding the stator housing to a heat-exchanger surface cast into the pump backplate. The circulating oil shall transfer excess motor heat directly to the pumped media inside the pump volute, without the need of submergence for adequate motor cooling at any continuous power output up to and including rated powers in ambient of 40° C. Alternately, motors shall dissipate heat directly (by convection) from the exposed stator housing to surrounding ambient air, without the need of submergence for adequate motor cooling at any continuous power output up to and including rated power in ambient of 40° C.
4. Motor stator windings and leads shall be insulated with moisture-resistant Class F insulation for operation at temperatures up to 155 degrees Celsius.
5. Motors shall have the stator varnish applied by the "vacuum-pressure impregnation" method to ensure thorough and complete varnish penetration. The stator shall be heat-shrink fitted into the stator housing.
6. Motor cable-entry sealing assembly shall consist of the following five components to ensure a positive, redundantly watertight seal:
 - The sealing components shall be mechanically isolated from cable strains by a two-piece restraining clamp, which will securely grip the cable above the moisture-sealing components and bear any mechanical forces applied to the cable.
 - The cable moisture seal shall consist of an elastomer grommet, prevented from extruding past the cable by stainless-steel retaining washers on either side. The grommet shall be compressed tightly against the cable outside diameter (and the entry assembly inner diameter) by a screwed follower gland.
 - Each individual conductor shall be interrupted by a solid-copper isolation dam to prevent wicking of moisture through the conductor strands.

- The cable insulation shall be sealed by an epoxy poured into the cable entry and totally encapsulating the stripped-back insulation and the individual copper dams. This poured epoxy seal shall also function as a redundant seal for the cable outside diameter.
 - The cable free end shall be sealed from moisture-entry during shipping, storage, and prior to connection to the control panel by a plastic sleeve securely clamped over the cable end. Motors which use only a compress-grommet gland, or only a poured epoxy seal, without benefit of redundancy of both types together, are not equal or acceptable.
7. Shaft sealing shall be by independently-mounted, tandem mechanical seals contained in an oil chamber that is formed as an intrinsic part of the motor frame and allows the seals to be completely submerged in and lubricated by the oil bath.
- The mechanical seal nearest the bearing shall utilize carbon/ceramic faces, and shall isolate the seal cooling oil from the motor frame.
 - The mechanical seal nearest the impeller shall be a stainless steel or rubber bellows-type construction firmly attached to the rotating face and clamped to the shaft, to prevent contaminants from contacting the stainless-steel spring which loads the seal face. The seal faces shall be a solid tungsten-carbide rotating face running against a solid silicon carbide stationary face. Seals with both faces of similar materials, or seals with bonded, soldered, or converted face surfaces are not equal or acceptable.
 - The mechanical seal nearest the impeller shall be contained in a seal chamber formed by the impeller flange and a recess cast into the motor frame. To prevent debris from entering the chamber and to prolong the mechanical seal life, a flush port shall be provided so that an optional external water flush can be supplied directly into the seal chamber.
 - The mechanical seal nearest the impeller shall be isolated from contaminants in the pumped media by a labyrinth-fit between the backside of the impeller and the backplate, as well as by pump-out grooves cast into the impeller back shroud and into the backplate, to minimize debris reaching the shaft seal.
 - Both inner and outer seals shall be dimensionally interchangeable with standard off-the-shelf, inch-size, John Crane mechanical seals, or equal, to allow second-source availability of seals from local distributors for emergency repairs.
8. The thrust bearings shall be designed to take the full axial load of the impeller.
9. Protection Devices. The motor shall be provided with the following protection devices:
- Two normally closed thermal sensors embedded in the stator windings, wired in series, will open a protective circuit if winding temperature exceeds rated operating temperature. These sensors automatically reset when winding temperature has cooled to a safe operating temperature.
 - A conductivity probe to monitor the moisture content of the oil in the chamber between the outer and the inner mechanical seals. The probe shall be wired to a

separate protective circuit, which, when connected to a conductivity-sensitive relay in the control panel, will trip an alarm if moisture content of the oil indicates a failure of the outer mechanical seal.

- Provide motor overtemperature and seal fail supervision relay MPE PMR1, or equal.

E. Power Cable, & Lifting Chain:

1. Provide power/control cable for pumps, Type SO or SJO jacketed cable, suitable for submersible wastewater application, sized in accordance with NEC requirements. Cable seal shall include a compressed rubber grommet to seal the cable exterior and epoxy fill to seal the interior passages. A strain relief device, in direct contact with both the cable and the cast iron entry housing, shall be provided. The cable entry shall be rated by Factory Mutual (or UL) for submerged operating depths to 65 feet. Power cable shall include control wiring for all items including overtemperature and seal failure.
2. Provide power cable, guides and lifting chain of following lengths:

Pump No.	Power Cable	Guide Rail	Lifting Chain
P-ML-1, 2	30'	19'-9"	25'

2.04 MOUNTING:

Quick Disconnect/Fast Out. The manufacturer shall provide a fast-out fixture, which shall be permanently mounted as shown by the drawings. The fixture shall cantilever the entire pump volute and motor from the volute discharge flange. The fixture shall include 90 degree cast-iron piping elbow to connect to vertical piping, and shall provide mounts for two stainless steel schedule 40 pipe rails, which will guide the pump into position. The pump shall be supported by a positive metal-to-metal interlocking flange, which is additionally sealed by a leak proof nitrile rubber ring pressed against the fixture flange by the weight of the pump.

3.00 EXECUTION

3.01 INSTALLATION

- A. All pumping equipment shall be installed in accordance with the manufacturer's instructions. All pump installations shall be checked by manufacturer's representative prior to start-up. Submersible pump installations shall be checked before the pumps are submerged or the wet wells are filled. Contractor shall furnish a written report prepared by the equipment supplier certifying the pumping equipment:
1. Has been properly installed and lubricated.
 2. Is in accurate alignment.
 3. Has been operated under full load conditions and that it has operated satisfactorily at rated conditions.

- B. Pump is to be installed in an existing basin without dewatering the basin. Proposed method of installation is as follows, other proposals which do not require dewatering the basin will be considered.
1. Pump manufacturer to size a concrete base that can be lowered into the basin. Concrete base to be sized to handle all forces imparted by the pumps normal and alternate operations (full-load pump starts and stops) without moving, such that the concrete base serves as a stable, immovable platform for pump mounting at the bottom of the basin. Concrete base to be formed and poured outside of the basin prior to installation.
 2. Discharge/base elbow for the pump discharge to be secured to the concrete base and vertical leg of discharge piping to be installed on base elbow outside of basin prior to lowering concrete into basin.
 3. Pump guiderails to be installed, secured to vertical section of discharge pipe prior to lowering the concrete base and discharge assembly into the basin.
 4. Interruptions to normal operations of the basin to be planned ahead and approved by the OWNER prior to installation. Installation may require minor lowering of basin contents. Settled solids may be present at the bottom of the basin where the pump is to be installed. Contractor shall remove solids as much as practical to clear the area on the bottom of the basin where the concrete base will be lowered.
 5. Concrete base, with discharge elbow, vertical discharge pipe, and guiderails lowered into basin and set at the correct location without need to secure base to the bottom of the basin.
 6. Secure discharge pipe to basin wall as necessary according to pump manufacturer's instruction to prevent pipe movement during operation, including pump starts and stops.
- C. Pump shall be set level and plumb with no stresses on the suction and discharge nozzles.
- D. Before connecting pumps to piping, all piping shall be thoroughly flushed and cleaned. All piping connected to pumps shall be supported from the adjacent structure without placing any load on the pumps. Whether shown or not, for all pumps (other than submersibles), the Contractor shall provide a rubber expansion coupling for isolating pump vibration from piping and piping movement due to temperature changes from pump, or for taking up misalignment between piping and pumps.
- E. Pump bases shall be bolted to the concrete equipment pad with stainless steel anchor bolts and nuts unless otherwise indicated. Grout leveling pads shall be used on top of concrete equipment pad with a minimum thickness of ½-inch. Nonshrink grout shall be used. Grout shall be neatly mitered from base and troweled smooth. All grout spatter shall be completely cleaned from all surfaces.
- F. After installation, adjustments and corrections shall be made to assure that the pump operates and functions satisfactorily and is in alignment. Remove all debris, all unused or rejected materials.

3.02 FACTORY TESTING FOR SUBMERSIBLE/IMMERSIBLE PUMPS

- A. Each pump shall be factory tested and certified test results submitted prior to delivery. A copy of the certified test results shall be submitted for review. The factory tests shall consist of the following steps:
1. Impeller, motor rating, and electrical connections shall be checked for compliance to the specifications.
 2. A motor and cable insulation test for moisture content or insulation defects.
 3. Each pump shall be run dry to establish correct rotation and mechanical integrity.
 4. Each pump shall be run for 30 minutes submerged, a minimum of 6 feet under water.
 5. After operational test No. 4, the insulation test (No. 2) is to be performed again.

3.03 TESTING AND PERSONNEL TRAINING

- A. The Contractor shall provide testing, adjust and operate the pumping equipment, and provide follow-up training by manufacturer's representative to demonstrate that all performance and operational requirements have been met and to demonstrate methods of servicing the pump/motor assemblies and installing spare parts. Operator instruction on proper pump operation and maintenance shall be for a minimum of 4 hours on each new pump type.
1. Tests shall include testing each pump:
 - a. For specified head and quantity of flow under normal operating conditions.
 - b. For proper and ease of removal and reconnection of pump in dry and submerged conditions.
 - c. For proper operation of all automatic controls and alarms as specified, for at least two cycles of all modes of operation.
 - d. For proper operation and stability of liquid level regulators.
 - e. Provide certified test results from pump manufacturer that pump operates satisfactorily for dry run for 24 hours, during which no liquid shall be allowed to enter the inlet of the pump and during which the exterior of the pump shall be dry and remain dry during the test.
 - f. For operation under "snore" conditions for two hours when the pump is alternately pumping liquid and air during the test.
 - g. For proper rotation of the impeller.
 2. Document all test procedures and results and submit to the Engineer.

****END OF SECTION****

1.00 GENERAL

1.01 Requirements

- A. The CONTRACTOR shall provide SAFE-Tank® or equal double wall high density cross-linked polyethylene tanks and accessories per section 2.05, complete and in place, in accordance with the Contract Documents.
- B. Unit Responsibility: The CONTRACTOR shall be responsible for furnishing the SAFE-Tank® double wall tank(s) and its accessories for chemical storage as indicated.

1.02 REFERENCES, CODES AND STANDARDS

- A. American Society of Testing Materials (ASTM).
 - 1. D638 Tensile Properties of Plastics
 - 2. D883 Standard Definitions of Terms Relating to Plastics
 - 3. D1505 Density of Plastics by the Density-Gradient Technique
 - 4. D1525 Test Method for Vicat Softening Temperature of Plastics
 - 5. D1693 ESCR Specification Thickness 0.125" F50-10% Igepal
 - 6. F412 Standard Terminology Relating to Plastic Piping Systems
- B. ANSI Standards: B-16.5, Pipe Flanges and Flanged Fittings
- C. Building Code: International Building Code, IBC 2009
- D. ARM: Low Temperature Impact Resistance (Falling Dart Test Procedure)
- E. NSF/ANSI Standard 61, AWWA – Drinking Water System Components
- F. ASTM D-1998, Standard Specification for Polyethylene Upright Storage Tanks

1.03 SUBMITTALS

- A. Shop Drawings: Shop drawings shall be approved by the engineer or contractor prior to the manufacturing of the SAFE-Tank® double wall tank(s). Submit the following as a single complete initial submittal.

Sufficient data shall be included to show that the product conforms to Specification requirements. Provide the following additional information:

- 1. SAFE-Tank® double wall tank and Fitting Material
 - a. Resin Manufacturer Data Sheet
 - b. Fitting Material

- c. Gasket style and material
- d. Bolt material
- 2. Dimensioned Tank Drawings
 - a. Location and orientation of openings, fittings, accessories, restraints and supports.
 - b. Details of manways, flexible connections, and vents.
- 3. Calculations shall be stamped and signed by a registered, third party engineer in the state of the installation.
 - a. Wall thickness. Hoop stress shall be calculated using 600 psi @ 100 degrees F.
 - b. Tank restraint system. Show seismic and wind criteria.
- B. Manufacturer's warranty
- C. Manufacturer's unloading procedure (see Poly Processing Company Installation Manual)
- D. Manufacturer's installation instructions (see Poly Processing Company Installation Manual)
- E. Supporting information on Quality Management System.
- F. Manufacturer's Qualifications: Submit to engineer a list of 5 installations in the same service as proof of manufacturer's qualifications.
- G. Electrical heat tracing and foam insulation data sheets as required.
- H. Factory Test Report
 - 1. Material, specific gravity rating at 600 psi @ 100 degrees F. design hoop stress.
 - 2. Wall thickness verification.
 - 3. Fitting placement verification.
 - 4. Visual inspection
 - 5. Impact test
 - 6. Gel test
 - 7. Hydrostatic test
- 1.04 QUALITY ASSURANCE
 - A. The Contractor shall supply SAFE-Tank® double wall tanks of the high density cross-linked polyethylene. Tanks furnished under this Section shall be supplied by Poly Processing Company or approved equal who has been regularly engaged in the design and manufacture of chemical storage tanks for over 10 years.

B. Tanks shall be manufactured from virgin materials.

1.05 WARRANTY

A. The tank manufacturer shall offer a limited 5 year full replacement warranty.

2.00 PRODUCTS

2.01 General

A. Tanks shall be rotationally-molded, high density cross-linked polyethylene, double wall, Safe-tank®, flat bottom tanks -. The assembly consists of one cylindrical, closed top inner primary tank and one cylindrical, open top containment outer tank. Each tank is a rotationally molded one-piece seamless constructed tank. The SAFE-Tank® tanks are designed for above-ground, vertical installation and are designed to store approved chemicals at atmospheric pressures. The assembly shall be designed to prevent rainwater and debris from entering the containment tank. Tanks shall be adequately vented as prescribed in Poly Processing Company's Technical Bulletin, Venting-Design for ACFM (air cubic feet per minute). Where indicated, tanks shall be provided with ancillary mechanical fittings and accessories. Tanks shall be marked to identify the manufacturer, date of manufacture and serial numbers must be permanently embossed into the tank.

2.02 MANUFACTURER

A. Tanks shall be manufactured by Poly Processing Company or equal.

2.03 POLYETHYLENE STORAGE TANKS

A. Service: Chemical storage tanks shall be suited for the following operating conditions:

B. High Density Cross-linked Polyethylene resin used in the tank manufacture shall be Poly CL™ or equal and shall contain ultraviolet stabilizer as recommended by resin manufacturer. Where black tanks are indicated, the resin shall have a carbon black compounded into it. The tank material shall be rotationally molded and be a resin that is commercially available at the time of tank manufacture.

C. **Wall thickness** for a given hoop stress is to be calculated in accordance with ASTM D 1998. Tanks shall be designed using a hoop stress no greater than 600 psi. In NO case shall the tank thickness be less than design requirements per ASTM D 1998.

1. The wall thickness of any cylindrical portion at any fluid level shall be determined by the following equation:

$$T = P \times OD/2SD \text{ or } 0.433 \times SG \times H \times OD/2SD$$

Where: T = wall thickness, in
P = pressure, psi
SG = specific gravity, gm/cc
H = fluid head, ft
OD = outside diameter, ft
SD = hydrostatic design stress, 600 psi

DOUBLE WALL HD XLPE CHEMICAL STORAGE TANKS

- a. The minimum wall thickness shall be sufficient to support its own weight in an upright position without external support but shall not be less than 0.187” thick.
2. On closed top tanks the top head shall be integrally molded with the cylindrical wall. Its minimum thickness shall be equal to the thickness of the top of the straight sidewall. In most cases, flat areas shall be provided for attachment of large fittings on the dome of the tank.
3. The bottom head shall be integrally molded with the cylindrical wall. Knuckle radius shall be:

Tank Diameter, ft	Min Knuckle Radius, in
less than or equal to 6	1
greater than 6	1-1/2

4. Tanks with 3000 gal capacity or larger shall have at least 3 lifting lugs. Lugs shall be designed for lifting the tank when empty.
 - a. Unless otherwise indicated by Contract drawings, for indoor pneumatic fill, manways shall be 24-in diameter or greater and equipped with an emergency pressure relief device or SAFE- Surge™ Manway with pressure relief at 6” water column to prevent over-pressurization. The SAFE-Surge manway shall be chemically compatible with the chemical being stored. Gaskets shall be closed cell, cross-linked polyethylene foam, Viton, or EPDM materials.
 - b. Unless otherwise indicated by Contract drawings, for outdoor pneumatic fill, manways shall be 24-in diameter or greater and equipped with Poly Processing Company’s F.S.2650® combined manway and vent to prevent over pressurization of tank. Manway must be capable of relieving a volume flow rate of up to 2650 ACFM. Gaskets shall be closed cell, cross-linked polyethylene foam, Viton, or EPDM materials.
 - c. Unless otherwise indicated, tanks less than 2000 gallons in non-pneumatic applications shall have a manway cover 17-in or smaller of Polyethylene material with a coarse thread. Gaskets shall be closed cell, cross-linked polyethylene foam, viton or EPDM materials.

NOTE: Tanks must be vented to allow for performance at atmospheric pressure, in accordance with the following matrix:

Venting Requirements For Polyethylene Tanks									
Mechanical Pump Fill	Pneumatic Fill								
IF ≤ 1000 gallons	IF - Vent length ≤ 3 feet			IF - Vent length > 3' and ≤ 30'			IF - Scrubber Application		
Vent size should equal size of largest fill or discharge fitting	AND - Vent screen mesh size ≥ 1/4" or no screen used			AND - 3 or less 90° elbows with no other restrictions or reduction in pipe size			Vent pipe size throughout scrubber system CANNOT be reduced!		
	Centerline of dispersion pipe not to be submersed > 6 inches						Perforated dispersion pipe must be same diameter or larger, as vent. Sum of perforations ≥ cross sectional area of pipe		
IF > 1000 gallons	Emergency Pressure Relief Cover Required			Emergency Pressure Relief Cover Required					
Vent size should exceed the largest fill or discharge fitting by 1 inch	Tanker Discharge	Inlet/Fitting Size	Minimum Vent Size	Tanker Discharge	Inlet/Fitting Size	Minimum Vent Size	Tanker Discharge	Inlet/Fitting Size	Minimum Vent Size
	2"	2"	4"	2"	2"	6"	2"	2"	6"
	3"	2"	6"	3"	2"	6"	3"	2"	8"
	3"	3"	6"	3"	3"	8"	3"	3"	10"

(2) 2 inch vents **DO NOT EQUAL** 4 inch venting capacity

For detailed venting guidelines, please visit our Technical Resources at www.polyprocessing.com

rev. Nov 2006

DOUBLE WALL HD XLPE CHEMICAL STORAGE TANKS

D. Tank colors shall be natural (un-pigmented), black (compounded), or as specified by the ENGINEER with written agreement by the tank manufacturer.

2.04 TANK ACCESSORIES

A. Ladder:

1. [Painted carbon steel], [fiberglass], [galvanized carbon steel] or [stainless steel] access ladders shall be provided with the polyethylene chemical storage tanks at locations as shown. Safety cages shall be added to ladders as required, per OSHA.
2. Ladders must be secured to the tank and secured to the concrete to allow for tank expansion/contraction due to temperature and loading changes. Use proper chemical resistant materials when anchoring to tank dome or sidewall. See Poly Processing Company's Tank Installation Manual.
3. All ladders shall be designed to meet applicable OSHA standards. Reference:
4. OSHA 2206; 1910.27; fixed ladders.

B. Restraint System:

1. Metal components to be [galvanized], [stainless steel], or [painted clips], edge softeners, and tension ring with [stainless steel], [galvanized] cables and clamps.
2. Tank restraint system shall be supplied and the design of same certified by a Structural Engineer registered in the State of tank installation. Design shall conform to the most recent edition of the IBC code for seismic and wind load. Anchor bolts as required by the calculations shall be supplied by the tank manufacturer.

2.05 TANKS:

A. Tank Schedule per the following specifications

Tank Schedule

Tank # by Service	Process	Fluid Operating Temp.	Tank Specific Gravity	Resin	Fitting Material	Gasket Material	Bolt Material
1	Aluminum Sulfate (alum, 48%)	ambient	1.9	XLPE With OR-1000	PVC	EPDM or Viton	316 Stainless steel
2	Sodium Hydroxide (25%-50%)	ambient	1.9	XLPE With OR-1000	PVC	EPDM or Viton	316 Stainless steel

DOUBLE WALL HD XLPE CHEMICAL STORAGE TANKS

Table 43 41 42-2.05-2								
Tank #	Qty	Working Capacity (gallons)	Nominal Diameter	Overall Height (see note 1)	Location: Indoors / Outdoors	Color	Insulation	Delta T Value
1	1	1,550	8'-01"	6'-11"	Indoors	As Required	N/A	N/A
2	1	1,015 (normal operations)	6'-5"	6'-7"	Indoors	As Required	N/A	N/A

Note: Approximate overall height is measured along the straight cylindrical portion of the tank and includes the dome top.

Fittings and attachments

Tank fittings shall be as required per the piping layout in the Drawings and according to the fitting schedule below.

Table 43 41 42-2.05-3 Fitting Sizes									
Tank#	Chemical	SAFE-Surge Manway	Level Switch	U-Vent	Fill Line Assembly	Top Inlet	Level Indication	Pump Outlet	Drain
1	Aluminum Sulfate	17"	3"	2"	2"	3@ 1&1/2"	2@2"	1"	2"
2	Sodium Hydroxide	17"	3"	2"	2"	3@1"	2@2"	1"	2"

Note: Approximate overall height is measured along the straight cylindrical portion of the tank and includes the dome top.

B. Fittings

1. Tank fittings shall be according to the fitting schedule in 2.05C above. Threaded fittings shall use American Standard Pipe Threads. If tanks are insulated, fittings shall be installed at the factory prior to application of the insulation.
2. Bolted flange fittings shall be constructed of one 150 lb. flange with ANSI bolt pattern, one flange gasket and stud bolts with gaskets. Stud bolts to have chemical resistant polyethylene injection molded heads and gaskets to provide a sealing surface between the bolt head and the interior tank wall. Stud bolt heads are to be color coded for visual ease of identifying the bolt material by onsite operators. Green- 316 Stainless Steel, Black- Titanium, Red- Alloy C-276, Blue- Monel. All materials shall be compatible with chemical service and as indicated in the fitting schedule above. For NSF/ANSI 61 certification, EPDM or Viton GF gaskets shall be supplied.
3. Down Pipes and Fill Pipes: Down pipes and fill pipes shall be supported at 6-ft max intervals. Down pipes and fill pipes shall be PVC or material compatible with the chemical stored.
4. U-Vents: Each tank must be vented for the material and flow and withdrawal rates expected. Vents should comply with OSHA 1910.106(F)(iii)(2)(IV)(9). U-vents shall be sized by the tank

manufacturer and be furnished complete with insect screen if required (Insect screen lessens the vent capacity by 1/3) in accordance with the venting schedule listed above.

5. On dual wall tank(s) greater than 1000 gallons, bottom fitting(s) must be designed to maintain 110% secondary containment integrity. Bottom containment fitting must include PTFE expansion joint designed to accommodate movement of primary tank in design accordance with ASTM-D 1998 tolerances. All secondary containment fittings and parts shall be resistant to chemical fume corrosion. Fitting shall include the option to connect a secondary containment pipe over primary pipe.
6. All fittings on the 1/3 lower sidewall of tanks with capacities \geq 1000 gallons shall have 100% virgin PTFE Flexijoint® expansion joint. Expansion joint to have 3 convolutions, stainless steel limit cables, FRP composite flanges and meet the following minimum performance specifications. Galvanized parts will not be accepted.

Expansion joints to meet the following minimum performance requirements:

Axial Compression \geq 0.67”

Axial Extension \geq 0.67”

Lateral Deflection \geq 0.51”

Angular Deflection \geq 14°

Torsional Rotation \geq 4°

2.06 LEVEL INDICATION

- A. Float Indication: The level indicator shall be assembled to the tank and shall consist of PVC float, indicator, polypropylene rope, perforated interior pipe, PVC roller guides, clear UV resistant PVC sight tube EnviroKing® by C.F. Harvel, and necessary pipe supports. The level indicator shall act inversely to the tank contents and shall not allow entrance of tank contents into the sight tube at any time. Indicator shall be neon orange color for visual ease for onsite operators.
- B. Ultrasonic Level Indicator: The ultrasonic level indicator shall be a Flowline ultrasonic level transmitter, level controller with one 4-20 mA or 0-10 VDC continuous level input and NEMA 4X box to be supplied by tank manufacturer.

2.07 FACTORY TESTING

A. Material Testing

1. Perform gel and low temperature impact tests in accordance with ASTM D 1998 on condition samples cut from each polyethylene chemical storage tank.
2. Degree of Crosslinking. Use Method C of ASTM D 1998- Section 11.4 to determine the ortho-xylene insoluble fraction of cross-linked polyethylene gel test. Samples shall test at no less than 60 percent.

B. Tank Testing

1. Dimensions: Take exterior dimensions with the tank empty, in the vertical position. Outside diameter tolerance, including out-of-roundness, shall be per ASTM D 1998. Fitting placement tolerance shall be +/- 1/2-in vertical and +/- 1 degree radial.
2. Visual: Inspect for foreign inclusions, air bubbles, pimples, crazing, cracking, and delamination.
3. Hydrostatic test: Following fabrication, the bottom tanks, including inlet and outlet fittings, shall be hydraulically tested with water by filling to the top sidewall for a minimum of 1 hour and inspected for leaks. Following successful testing, the tank shall be emptied and cleaned prior to shipment.

3.00 EXECUTION

3.01 DELIVERY, STORAGE, AND HANDLING

- A. The tank shall be shipped upright or lying down on their sides with blocks and slings to keep them from moving. AVOID sharp objects on trailers.
- B. All fittings shall be installed and, if necessary, removed for shipping and shipped separately unless otherwise noted by the contractor.
- C. Upon arrival at the destination, inspect the tank(s) and accessories for damage in transit. If damage has occurred, Poly Processing Company shall be notified immediately.

3.02 INSTALLATION

- A. Install the tanks in strict accordance with Poly Processing Company's Tank Installation Manual and shop drawings.
- B. Installation will be inspected by manufacturer to verify system flexible connections, venting and fittings are properly installed. In addition to on-sight inspection tank system(s) to be reviewed using tank manual check list as supplied by manufacture as listed below.
- C. Manufacturer to provide 1 hour training session to prepare operators to service and maintain the tank system. Included in training session will be (#) training manuals.
- D. Manufacturer's trained technician to do an onsite inspection of installation. Inspection will verify chemical application, plumbing connections, venting, and applicable ancillary equipment such as ladders, restraints, etc. A verification of proper installation certificate will be supplied when equipment passes installation checklist.
- E. Tank manuals will consist of installation check lists, tank drawing(s) as built, fitting drawings referencing nozzle schedule on tank drawing, materials of construction, and recommended maintenance program.

3.03 FIELD TESTING

- A. Poly Processing Company recommends that all tanks be hydro-tested for 24 hours prior to commissioning.

****END OF SECTION****

1.00 GENERAL

1.01 DESCRIPTION OF WORK

- A. Work covered by this section consists of furnishing, installing, testing, and placing into operation three (3) fiberglass reinforced plastic (FRP) tanks as specified in this section and shown on the Contract Drawings.

1.02 RELATED WORK

- A. Section 01 33 00 - Submittals Procedure
- B. Section 01 60 00 – Product Requirements
- C. Section 01 75 00 – Testing, Start-Up, and Training
- D. Section 10 14 00 - Signage
- E. Section 40 05 90 - Common Work Results for Process Equipment

1.03 REFERENCES, CODES AND STANDARDS

- A. American Society of Testing Materials (ASTM)
1. C581 Practice for Determining Chemical Resistance of Thermosetting Resins Used in Glass-Fiber-Reinforced Structures Intended for Liquid Service
 2. C582 Specification for Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion-Resistant Equipment
 3. D2150 Specification for Woven Roving Glass Fabric for Polyester-Glass Laminates
 4. D2563 Standard Practice for Classifying Visual Defects in Glass-Reinforced Plastic Laminate Parts
 5. D2583 Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor
 6. D2584 Test Method for Ignition Loss of Cured Reinforced Resins
 7. D3892 Practice for Packaging/Packing of Plastics
 8. D4024 Specification for Machine Made Fiberglass (Glass-Fiber-Reinforced Thermosetting Resin) Flanges
 9. D5421 Specification for Contact Molded Fiberglass (Glass-Fiber-Reinforced Thermosetting Resin) Flanges
- B. American National Standards Institute/American Society of Mechanical Engineers
- ANSI/ASME B-16.5 Pipe Flanges and Flanged Fittings

- C. American Society of Civil Engineers (ASCE)/Structural Engineering Institute (SEI)
ASCE/SEI 7 Minimum Design Loads For Buildings and Other Structures
- D. American Society of Mechanical Engineers (ASME)
RTP-1 Reinforced Thermoset Plastic Corrosion-Resistant Equipment
- E. International Building Code (IBC), Latest Edition
- F. Occupational Safety and Health Administration (OSHA)
29 CFR 1910.27 Occupational Safety and Health Standard for Fixed Ladders

1.04 SUBMITTALS

- A. Furnish submittals in accordance with Section 01 33 00 - Submittal Procedures. In addition, submit the following:
 - 1. Product Data: Submit product data sheets for all items proposed for use, including:
 - a. Resin.
 - b. Laminate.
 - c. Reinforcing material.
 - d. Chemical compatibility chart for the resin and reinforcing material.
 - e. Certification from resin manufacturer regarding resin chemical resistance.
 - f. Surface layer composition.
 - g. Structural layer composition.
 - h. Color chart for external tank coating.
 - i. All accessories furnished with tank.
 - j. Fabrication techniques, sequencing on laminating, and curing.
 - k. Fitting Material.
 - l. Gasket style and material.
 - m. Bolt material and patterns.
 - 2. Tank Drawings
 - a. Plan, elevation and detail views showing weights and dimensions.

- b. Height and orientation of openings, nozzles, fittings, accessories, restraints, supports, and lifting lugs.
 - c. Tank profile showing the entire laminate system indicating thickness, resin designation, reinforcement, and surface mat material of each layer including the structural and corrosion barrier layers.
 - d. Details of all equipment and accessories to be furnished with the tanks including nozzles, inlet and outlet fittings, vents, drains, manways, gaskets, ladder, and their support systems. Indicate material of construction on drawings.
 - e. Anchor bolt drawings that show all data and details required to install the tanks and accessories to the concrete foundation including the size, type, location, dimensions, and projection for each type of anchor bolt.
3. Design calculations, stamped and signed by a registered, professional engineer that shall include:
- a. Wall thickness.
 - b. Tank restraint system, lifting lugs, and tie-downs.
 - c. Anchor bolt type, size, and location.
 - d. Dead loads.
 - e. Live loads
 - f. Environmental loads (e.g., seismic).
4. Warranties as specified.
- B. Factory Test Reports
1. Material test data verifying physical properties.
 2. Wall thickness verification.
 3. Fitting placement verification.
 4. Visual inspection test
 5. Barcol hardness test
 6. Acetone sensitivity test
 7. Glass content test
 8. Hydrostatic test

- C. Fabricator's Certificate of Compliance that vessel was manufactured in accordance with these Specifications.
- D. Bill of materials.
- E. Operation and maintenance data per Section 01 33 00 - Submittal Procedures, and also including:
 - 1. Manufacturer's unloading and storage procedures.
 - 2. Manufacturer's installation instructions.

1.05 **QUALIFICATIONS**

- A. Tank manufacturer must be engaged in the design and manufacture of FRP aboveground vertical chemical storage tanks for over 10 years with at least 10 installations similar to this project in the U.S.
- B. Experience information shall be furnished with shop drawings. The term "installations" shall mean individual projects/contracts. The installations shall include, but not be limited to, the following:
 - 1. Name and location of installation.
 - 2. Type, size, and chemicals stored for tanks.
 - 3. Month and year the tanks were placed into operation.
- C. Tank manufacturer shall have an ASME RTP-1 Certificate of Authorization.

1.06 **BIDDING AND PAYMENT**

- A. The cost of the tanks shall be included in the lump sum bid price for the Tertiary Filtration Building.
- B. The tanks shall be separate unit price item in the Schedule of Values.

1.07 **WARRANTY**

- A. Tank manufacturer shall warrant the materials and installation to be free of defects in materials and workmanship for a period of three (3) years from the Date of Substantial Completion and in accordance with the General Conditions.

2.00 PRODUCTS

2.01 **MANUFACTURER**

- A. Plas-Tanks Industries Inc., Hamilton, OH.
- B. Ershigs, Bellingham, WA
- C. Belco Manufacturing, Portland, OR/Belton, TX

D. Engineer-approved equal.

2.02 TANK SCHEDULE

Tank#	Number of Tanks	Contents and process	Fluid Operating Temp.	Total Capacity (gallons)	Nominal Inside Diameter	Nominal Height	Gasket Material	Bolt Material
1	1	Treated effluent. Rapid mixing	4°C - 25°C	1,468+/-	5'-0"	10'-0"	EPDM	316 SS
2	1	Treated effluent. Coagulation	4°C - 25°C	4,294+/-	8'-0"	11'-5"	EPDM	316 SS
3	1	Treated effluent. Flocculation	4°C - 25°C	4,294+/-	8'-0"	11'-5"	EPDM	316 SS

2.03 FRP TANKS

A. Type

1. Cylindrical in cross-section
2. Vertical
3. Flat-bottomed
4. Single-wall

B. Design Conditions

1. Pressure: Atmospheric
2. Location: Indoors
3. Heating: Not required

C. Design Standards

1. Tanks shall be fiberglass reinforced plastic (FRP) designed and manufactured in accordance with ASME RTP-1, and other applicable ASTM standards listed in this Section.
2. Laminate Quality: Tanks shall comply with ASME RTP-1, Level II for: appearance, defects, cut edges, and construction joints.
3. Tanks shall be designed to withstand a hydrostatic head 6 inches above the top of tank.

D. Corrosion Resistance

1. Tanks materials shall be suitable for biologically treated effluent with chemical addition as follow: sodium hydroxide maximum 100 mg/L added. Aluminum sulfate, maximum added 200 mg/L.

E. Resin

1. Resin shall be corrosion grade vinyl ester resin or superior, Hetron™ epoxy vinyl ester resin or equal.
2. The same resin shall be used throughout the structure.
3. No dyes, pigments or colorants shall be used except in the exterior coat.
4. Resin shall not contain fillers or thixotropic agents unless specified.
5. Ultraviolet absorbers shall be added to the exterior surface resins.

F. Reinforcement

1. Inner Surface:

- a. Veil will be one or two ply synthetic fiber veil, or a chemically resistant Type C glass veil, depending on resin manufacturer's recommendation.
- b. Synthetic fiber veil may be backed by one ply chemically resistant Type C glass veil to improve inner surface quality.
- c. Inner surface shall have a minimum of 85% resin content and shall have a minimum thickness of 10 to 20 mils.

2. Interior layer:

- a. Two (2) layers of 1.5 oz/ft² chopped strand mat Type E glass or equivalent chopped strand backing the veil.
- b. Application by chopper gun is acceptable if mechanically slaved and synchronized to the rotation of the mandrel.
- c. Interior layer shall have 68% to 78% resin content.
- d. Use no additive in the corrosion barrier.
- e. The inner surface and interior layer are corrosion barriers shall not be considered in the structural design.
- f. The combined thickness of the inner surface and interior layer shall be minimum 100 mils.

3. Structural Layers

- a. Filament Wound (shell): Continuous roving used for filament winding shall be Type ECR glass with a silane type finish, with a nominal yield of 250 strand yards per pound. Glass content for filament wound layers shall be 55%-70%. Uni-directional fabric may be interspersed between filament wound layers to achieve minimum axial tensile properties.
 - b. Hand Lay-up (heads, joints, fittings): Alternating layers of 1.5 oz/ft² chopped strand ECR-glass or equivalent chopped glass and 24 oz/yd² woven roving. Woven roving shall be Type ECR glass, nominal 24 ounces per square yard, 4 x 5 weave, with silane type finish. Glass content for hand lay-up layers shall be 30% to 45%.
4. Exterior Layer:
- a. A resin rich surface layer reinforced with Type C glass veil. The exterior shall be finished with two pigmented gel coats containing UV inhibitors. An outer layer of paraffin to promote complete curing of resin shall be included.
5. Laminates:
- a. The required laminate thickness shall be construction minimums.
 - b. Verify that minimum thicknesses are obtained using the laminate sequences specified.
 - c. When only total laminate thickness is specified, the minimum allowable structural laminate thickness shall be the total laminate thickness less the exterior protective coating.
 - d. Interruptions in laminating sequences shall follow the application of a ply of mat and be succeeded by a ply of mat.
 - e. The interruption shall not exceed 24 hours, and the in-process surface must retain acetone sensitivity until laminating is resumed.
 - f. Lack of compliance with these aspects or indication that contamination of the surface has occurred shall require that surface preparation be accomplished before resuming.
6. Joints
- a. The width of the first layer shall be 3 in. minimum. Successive layers shall uniformly increase in width to form a smooth contour laminate that is centered on the joint +/- 1/2 in.
 - b. A highly filled resin paste shall be placed in the crevices between joined pieces, leaving a smooth surface for lay-up.
 - c. The cured resin surfaces of parts to be joined shall be roughened using abrasive media to expose glass fibers. This roughened area shall extend beyond the lay-up areas so that no reinforcement is applied to an unprepared surface. Surfaces shall

be clean and dry before lay-up. The entire roughened area shall be coated with paraffinated resin after joint overlay is made.

- d. The interior overlay of a joint shall consist of a minimum of two plies of 1.5 oz/ft chopped strand mat reinforcement, followed by a resin-rich layer reinforced with surfacing mat.
- e. The outer structural overlay of a joint shall be centered on the joint and shall be finished.

G. Seismic Design

1. Tank design shall comply with IBC and ASCE/SEI 7 for seismic design.
2. Tanks and supports shall be designed to resist stresses created by the maximum seismic load when the tank is full of 1.65 specific gravity liquid.
3. Tanks shall be equipped with stainless steel lifting lugs and 316 stainless steel tie-down, attached to the tank at appropriate locations, to withstand appropriate seismic loads, either empty or full.
4. Structural calculations demonstrating compliance with local seismic codes shall be certified by a professional engineer and submitted for approval.
5. All anchor bolts and hardware shall be 316 stainless steel.

H. Cover/Top

1. Tanks shall be open-top. Reinforcement at rim shall be as required by the tank manufacturer.
2. Contractor to coordinate tank dimensions, including rim reinforcement, with access catwalk and mixer support systems.
3. Support of auxiliary equipment (mixing), and operation personnel will not require additional reinforcing, as maintenance access catwalks and equipment support structures will be provided separately as shown on the plans.

I. Bottom

1. Bottom knuckle radius of flat bottom tanks shall be a minimum of 1.5 inches.
2. The reinforcement of the knuckle-radius area shall extend up the vertical wall a minimum of 12 inches.
3. The tank bottom shall not have variations from a nominally flat plane that would prevent uniform contact of the entire bottom surface with a properly prepared flat support surface when the tank is filled with liquid.

J. Dimensions and Tolerances

1. Standard tank diameters are based on internal measurements with the tank in the vertical position.
2. Tolerance on the inside diameter, including out-of-roundness, shall be +/- 1%.
3. Shell taper shall be additive to the figure used for the tank diameter. Shell taper shall not exceed ½ degree per side.
4. Tolerance on overall tank height shall be ½%, but shall not exceed +/- ½ in.
5. Nozzle flange faces shall be perpendicular to the axis of the pipe and shall be flat within +/- 1/32 in. through 18 in. nozzle size and 1/16 in. for large nozzle sizes.

2.04 FITTINGS AND ATTACHMENTS

- A. Tank fittings shall be as required per the piping layout in the Drawings and according to the fitting schedule below. Orientation of nozzles is shown in the drawings.

Fitting Sizes							
Tank#	Service	Inlet (no.)	Inlet (size)	Inlet Nominal C.L. above tank base	Outlet (no.)	Outlet (size)	Outlet Nominal cl above tank base
1	Rapid mix	1	10"	1'-8"	1	12"	6'-6"
2	Coagulation	1	12"	8'-1"	2	12"	1'-1"
3	Flocculation	2	12"	1'1"	1	18"	9'-2"

B. Lifting lugs

1. Tanks shall be equipped with stainless steel lifting lugs, attached to the tank at appropriate locations for use to lift the tank by hoisting equipment. The number and location of the lifting lugs shall be designed by the manufacturer.

C. Nozzles:

1. Each tank shall be furnished complete with nozzles required by the drawings and specifications – see fitting schedule above.
2. Nozzles shall have a 6-inch projection as measured from the face of the flange to the outside wall of the tank.
3. Shell nozzles shall be mounted radially, perpendicular to the side shell.
4. Nozzles shall be finished flush with the inside surface of the tank.
5. Pipe connection/fitting fabrication in the field will not be acceptable.

6. All fitting connections shall be reinforced with gussets.
7. Gaskets shall be provided for blind flanges if used.
8. Unless otherwise required by the piping layout, tanks shall have full face fiberglass, standard stubs with 150-pound ANSI B16.5 FRP full face flanges for pipe connections.
9. Bottom nozzles with centerline located 6 inches or more away from the tank bottom shall be equipped with siphon pipe to allow complete the tank to drain completely.

D. Tank Identification:

1. Identify each tank with the Manufacturer's name and location, capacity in gallons, design maximum temperature, design pressure, chemical service, including concentration, specific gravity, vessel "tag" number, vessel name, resin type, and date of manufacture.

E. Tank Baffles:

1. Tanks shall be supplied with anti-swirl and anti-vortex baffles. Baffling shall be as recommended by the mixer supplier, providing mixers through the tertiary filtration system supplier, fabricated of materials compatible with the application. Baffles shall be installed and assembled into the tanks by the tank supplier at the factory. Contractor shall be responsible for coordination of supply of baffles.

3.00 EXECUTION

3.01 CURING

- A. Curing system shall be as recommended by resin manufacturer for the intended chemical service.
- B. Cool to ambient temperature before performing factory tests.

3.02 FACTORY TESTING

- A. Visual Inspection Test: Tanks shall be visually inspected for compliance with ASME RTP-1, Level II.
- B. Barcol Hardness Test: Tanks shall be tested in accordance with ASTM D2583. Ten readings will be taken on the clean, resin rich surface of the tank. Minimum Barcol hardness shall be 90% of the value specified by the resin manufacturer.
- C. Acetone sensitivity test for all internal secondary bonds.
- D. Glass content by ignition loss on three cutouts per ASTM D2584.
- E. Hydrostatic test: Following fabrication, the tanks, including inlet and outlet fittings, shall be hydraulically tested with water for a minimum of 2 hours and inspected for leaks. Following successful testing, the tank shall be emptied and cleaned prior to shipment.

3.03 POST CURING:

- A. After fabrication and inspection, where recommended by the resin manufacturer, all tanks shall be post cured with heat.
- B. Post curing shall use indirect heaters or steam to avoid hot spots.
- C. Follow resin manufacturer's recommendations for post cure temperatures and times.
- D. Any material not meeting the recommended Barcol hardness after post curing shall be rejected. NOTE: synthetic veils, such as nexus, will reduce the Barcol readings by approximately 5 points.

3.04 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping:

- 1. All materials must be packaged, crated, protected, and secured in such a manner so as to prevent damage in handling and while in transit. Details of these procedures shall be the responsibility of the Manufacturer.
- 2. Tanks shall be mounted on padded cradles if shipped horizontally or on a suitable skid if shipped vertically.
- 3. All flanged nozzles shall be protected and secured.
- 4. All unflanged components shall either contain rigid plugs inside the ends to prevent deflection or shall be protected by adequate exterior wrapping.
- 5. The open ends of tanks shall be braced with suitable stiffening members to prevent deflection.
- 6. No components or other pieces shall be shipped loose inside of the tanks.
- 7. Tanks shall be loaded with at least 1" minimum clearance between the tank (including fittings) and the bulkheads or bed of the vehicle.
- 8. Regardless of the mode of transportation, all components shipped must be firmly fastened and padded to prevent shifting of the load or flexing of components while in transit.

- B. The Contractor shall inspect the tank(s) and accessories for damage in transit upon arrival at the destination. If damage has occurred, tank manufacturer shall be notified immediately.

3.05 INSTALLATION

- A. Contractor shall install the equipment specified herein in accordance with the Manufacturer's recommendations, drawings, and all applicable sections of the specifications.
- B. Verify that the concrete foundations are non-porous, free of cracks, depressions, and vertical projections, and flat. Repair any concrete irregularities per the specifications.

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- C. Contractor shall install signage on tanks in accordance with Section 10 14 00 – Signage.
- D. Manufacturer’s qualified representative shall inspect and certify the installation in accordance with Section 01 75 00, Testing, Start-Up, and Training.

3.06 FIELD TESTING

- A. All tanks shall be hydrostatically-tested for 24-hours prior to commissioning.

****END OF SECTION****

1.00 GENERAL

1.01 SUMMARY

- A. The work in this Section consists of designing, furnishing, and installing a hydraulic screenings flume and all associated appurtenances, accessories, electrical and controls for use and incorporation into the perforated plate filter screen system. Equipment shall be installed at the location shown on the Drawings and as specified herein, as recommended by the supplier and in compliance with all local, state and federal codes and regulations.
- B. The hydraulic screenings flume shall transport screenings from the Perforated Filter Screen to the conveyor compactor as shown on the drawings.
- C. Special provisions, requirements and/or revisions to this Specification and/or Bid Item(s) may be included in Section 01 01 00 (green pages) and/or on the Drawings or Details.
- D. Electrical and control components shall be in conformance with Division 26 of these contract documents.

1.03 REFERENCES

- A. The FSM Hydraulic Screenings Flume Model SW shall meet the requirements of the following industry standards:
 - 1. AISI (American Iron and Steel Institute)
 - 2. ANSI (American National Standards Institute)
 - 3. ABMA (American Bearing Manufacturers Association)
 - 4. AGMA (American Gear Manufacturers Association)
 - 5. NEMA (National Electrical Manufacturer's Association)
 - 6. NFPA (National Fire Protection Association)
 - 7. ASTM (American Society for Testing and Materials)
 - 8. WSC (American Welding Society Code)
 - 9. ASME (American Society of Mechanical Engineers)
 - 10. NEC (National Electrical Code)
 - 11. UL (Underwriters Laboratory Standards)
 - 12. IEEE (Institute of Electrical and Electronics Engineers, Inc.)
 - 13. AWS (American Welding Society) and D1.1, Structural Welding Code.
 - 14. NEC (National Electric Code)
 - 15. NEMA (National Electrical Manufacturers Association)
 - 16. CEMA (Conveyor Equipment Manufacturers Association)
 - 17. OSHA (Occupational Safety Health Administration)

1.02 MANUFACTURER

- A. The hydraulic screenings flume equipment manufacturer shall be of the same manufacturer as the perforated plate filter screen manufacturer.
- B. Equipment shall be designed/sized/selected by the manufacturer for this specific installation meeting the performance requirements herein. Acceptable models for the perforated plate filter

screen system are below. Manufacture shall confirm and demonstrate via submittal that the proposed models meet the performance criteria. Shall be Enviro-Care Company FSM Model SW300, or approved equal. Approval of an alternate shall follow process outlined in Article 11 of the Instructions to Bidders.

1.04 SUBMITTALS

A. Submittals shall conform to Section 01 33 00 of these Specifications, and shall include complete manufacturer's literature, drawings, installation instructions, operation and maintenance manuals and written warranties for all pieces of equipment and accessories.

B. Submittals shall include:

1. Certified general arrangement drawings showing all details including materials of construction, dimensions, loads on supporting structures, and anchor bolt locations. Arrangement shall show as-built dimensions (see as-built requirements herein).
2. Shop drawings, catalog cut sheets, and other materials required to completely describe and specify the system and equipment.
3. A list of all deviations from drawings and specifications.
4. Descriptive literature, bulletins and/or catalogs of the equipment.
5. Complete data on motors and gear reducers.
6. Wiring diagrams and electrical schematics for all control equipment to be furnished.

1.06 WARRANTY

A. Warranty for the perforated plate filter screen system and all associated equipment and appurtenances shall extend for 12 months after start-up.

B. Warranty shall include all parts, labor, shipping, and coatings for repairing or replacing equipment that fails during the warranty period. Defects occurring within the warranty period shall be repaired or replaced by the manufacturer at no cost to the Owner.

1.07 PRECONSTRUCTION AS-BUILT

Prior to construction Contractor shall obtain and provide to the manufacturer as-built information required for manufacturer design/selection/supply of the equipment and appurtenances specified herein to be installed at the location shown on the Drawings. Equipment shall be manufactured to accommodate existing conditions and for installation as shown, and shall include all required appurtenances, anchors, connections, and any other needed item for a complete and operational system sized for this specific installation and installed at the location shown in the Drawings. Any modifications required to existing structures, building, or other existing features shall be included in the amount bid.

1.08 DELIVERY, STORAGE AND HANDLING:

Items to be shipped as complete assemblies except where partial disassembly is required by transportation regulations or for protection of components. Equipment shall be delivered as completely assembled as practical to minimize field assembly. All equipment be pre-piped and pre-wired at the factory as much as practical. Contractor shall be responsible for unloading and any necessary field assembly. Contractor shall contact manufacturer for assembly requirements during bid.

1.09 SEQUENCING AND SCHEDULING:

Coordinate work with restrictions as specified in the Contract Documents. Perforated Plate Filter Screen system including hydraulic screenings flume sequencing will require temporary bypass structures in the headworks channel which shall be included in the amount bid. See Section 01 01 00 Special Requirements and Section 01 89 00 Sequence and Limitations of Construction.

2.00 PRODUCTS

2.01 QUALITY ASSURANCE

- A. Equipment manufacturer shall be ISO 9001 certified.
- B. The FSM Hydraulic Screenings Flume will be shipped to the site fully assembled, if possible, and dependent upon the overall length of the unit. Some ancillary components may be removed in order to prevent damage during shipment.

2.02 MINIMUM DESIGN PERFORMANCE REQUIREMENTS

Number of Units:	One (1)
Flume Trough Width:	12 inches
Solids Transportation Capacity:	70 ft ³ /hr
Overall Length (approximate):	5 feet
Installation Angle:	6-degree
Number of Inlets:	One (1)
Number of Outlets:	One (1)
Flume Water Flow Rate:	50-100 gpm @ 20-40 psi
Flume Water Connection:	2-inch npt

2.03 MANUFACTURER DESIGN REQUIREMENTS

- A. General:
 - 1. Shall be designed/selected by the manufacturer for this specific installation meeting the performance criteria herein, and as required for perforated plate filter screen to meet the performance requirements.
 - 2. The hydraulic screenings flume shall be a complete assembly consisting of a transition chute between the filter screens and flume. The hydraulic flume shall be designed to receive and transport the screenings to the conveyor compactor. The unit's transportation capacity shall be as required herein..
 - 3. Hydraulic Screenings flumes that use shaftless or shafted screws or belts to transport the screenings shall not be allowed.
 - 4. Refer to and comply with the design performance requirements list in Paragraph 2.03.

5. The hydraulic screenings flume shall be designed and built to withstand maximum possible forces exerted. All structural and functional parts shall be sized to prevent deflections or vibrations that may impair the units operations. All components of the hydraulic screenings flume shall be made of type 316 stainless steel.
6. Shop Surface Preparation/Coating: All weldments shall be cleaned and passivated using a full dip passivation process to remove weld spatter, slag and discoloration. Component weldments not full dipped passivated, using spray on cleaning solutions, passivating welds only or bead blasting shall not be allowed.

B. Flume

1. The flume shall be constructed from 11 gauge thick type 316 stainless steel. The flume housing shall be designed to support all required loads.
2. The flume shall be supplied with sections not exceeding 30 feet.

C. Support Legs

1. The flume shall be provided complete with supports suitable for anchoring to the concrete base.
2. Support legs shall be fabricated from 0.25-inch thick type 316 stainless steel.
3. The supports shall be designed to avoid interference with other equipment. The supports shall be designed to prevent excessive vibration or any portion of the flume system under all loading conditions and will be adjustable for leveling purposes.

D. Inlet Hoppers

1. The inlet hoppers shall be designed to accept discharge screenings from the filter screen discharge flume. The hopper shall connect directly to the screen discharge flume in such a way has to prevent any solids or water bypass/leakage.
2. The inlet hopper shall be fabricated from minimum 12-gauge type 316 stainless steel.

E. Covers

1. Protective covers shall be fabricated from minimum 14-gauge 316 stainless steel.
2. The covers shall be secured in place with hardware and allow for easy removal. Covers shall be fitted with gaskets to provide a water tight seal. Drain pan shall be constructed of

F. Water Supply

1. Contractor shall confirm sufficient supply of water shall be provided at the inlet end of the flume. The flume end plate will include a 2-inch npt water connection for this purpose.

G. Discharge Connection

1. The number of discharge connections shall be as noted in Paragraph 2.03.
2. The discharge shall be designed to transport the flumed screenings to the screenings wash press without plugging.
3. The discharge shall include a flanged connection as required with associated gaskets to create a water tight connection with no solids or water leakage/bypass.
4. The discharge connection shall be fabricated from minimum 14-gauge type 316 stainless steel.

2.04 ELECTRICAL CONTROLS AND DEVICES

A. Electrical: In addition to the drive motor, the equipment supplier shall furnish all electrical items specifically called for in this specification section. The contractor shall supply all other electrical items, and interconnecting wiring of proper size, including all conduit and supports required to place the equipment into service.

1. The following components will be included in the associated filter screen panel to provide proper operation of the equipment:
 - a. Hand-Off-Auto selector switch for the flume water solenoid valve.
 - b. Control relays and timers to provide necessary control logic and monitor equipment mounted electrical devices.
 - c. Run and alarm auxiliary contacts for use by the customer.
2. Local Control Station –
 - a. NEMA 7 rating – cast aluminum housing.
 - b. Open-Close-Remote Switch for water flow control valve.
3. Solenoid Valve: One (1) solenoid valves shall be provided to control water flow to the Flume. The brass body valves shall be 120 Volt, single phase, 60 Hz with a NEMA 7 housing.

B. Sequence of Operation

1. HAND OPERATION

- a. Flume Solenoid Valve: When HAND mode is selected, the flume water will run continuously.

2. AUTOMATIC OPERATION

- a. Flume Solenoid Valve: When AUTO mode is selected, the flume water solenoid is open whenever the screen(s) are in operation.

2.05 Anchorage and Fasteners

A. Anchor Bolts: All anchor bolts shall be a minimum of 1/2 inch diameter and made of type 316 stainless steel. The equipment supplier shall furnish all anchor bolts, nuts, and washers required for the equipment.

- B. Fasteners: All fasteners shall be type 316 stainless steel. The equipment supplier shall furnish all fasteners required for the assembly of the equipment.

3.00 EXECUTION

3.01 PREPARATION

- A. The mounting points shall be level and parallel and of proper size.
- B. Contractor shall verify all dimension in the field to ensure compliance of equipment dimensions with the drawings.

3.02 LIFTING AND MOVING EQUIPMENT

- A. Lifting points shall be identified on all Enviro-Care equipment. A crane of sufficient capacity must be on site for unloading the equipment from the truck and placing in the channel for installation.

3.03 INSTALLATION

- A. Installation shall be in strict accordance with the Manufacturer's recommendations and instructions and shall be in accordance with the specifications herein and the Drawings. Installation shall include all equipment, labor, materials, connections, or any other item needed for a complete and operational perforated plate filter screen.
- B. All equipment, components, piping and appurtenances shall be installed true to alignment and rigidly supported. Any damage caused by the negligence of the Contractor to the above items shall be repaired or replaced by the Contractor to its original condition.
- C. Interconnecting piping supplied by the Contractor to be hydrostatically tested by the Contractor.
- D. The screen system Manufacturer's representative to be present during placement and connection of the unit to instruct and observe installation.
- E. Manufacturer's representative to inspect the installation prior to startup in order to verify that the equipment has been properly installed.
- F. Manufacturer's representative shall calibrate the equipment with the Owner's operator present after installation prior to startup.
- G. All products, accessories, and appurtenances shall be installed in accordance with manufacturer's instructions and approved submittals.
- H. The Contractor shall provide all hardware and accessories required for installation.
- I. Anchor bolts and all needed connectors are to be sized by Manufacturer and provided by Contractor.

3.04 START UP/TRAINING/FIELD QUALITY CONTROL

HYDRAULIC SCREENINGS FLUME

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- A. Manufacturer shall provide installation instruction manuals for Contractor's assistance at least 30 days prior to shipment of factory assembled treatment units
- B. Manufacturer shall provide assistance regarding handling, assembly and installation requirements for complete installation by the Contractor.
- C. Manufacturer shall provide assistance as needed for construction of the perforated plate filter screen system.
- D. Contractor shall verify all equipment is installed in accordance with the manufacturer's recommendations and literature and the Drawings.

**** End of Section ****

1.00 GENERAL

1.01 SUMMARY

- A. The work in this Section consists of designing, furnishing, and installing a perforated plate filter screen system and all associated equipment, appurtenances, electrical and controls. Equipment shall be installed at the location shown on the Drawings and as specified herein, as recommended by the supplier and in compliance with all local, state and federal codes and regulations.
- B. Fine screen shall be furnished with perforated filter panels, drive chain, sprockets and bearings, rotating self-adjusting cleaner brush, deflector roller, spray water system, drive motors, gear reducers, anchor bolts, electrical/controls/instrumentation, hydraulic screenings flume, shaftless spiral conveyor/compactor, and any and all accessories and appurtenances specified or otherwise required for a complete and properly operating installation at the location specified. Work shall delivery and manufacturer installation assistance, inspection, certification of installation, functional testing, startup and job site training.
- C. Special provisions, requirements and/or revisions to this Specification and/or Bid Item(s) may be included in Section 01 01 00 (green pages) and/or on the Drawings or Details.
- D. Electrical and control components shall be in conformance with Division 26 of these contract documents.

1.03 REFERENCES

- A. The FSM Perforated Filter Screen Model FRSIII $\alpha\beta$ shall meet the requirements of the following industry standards:

- 1. AISI (American Iron and Steel Institute)
- 2. ANSI (American National Standards Institute)
- 3. ABMA (American Bearing Manufacturers Association)
- 4. AGMA (American Gear Manufacturers Association)
- 5. NEMA (National Electrical Manufacturer's Association)
- 6. NFPA (National Fire Protection Association)
- 7. ASTM (American Society for Testing and Materials)
- 8. WSC (American Welding Society Code)
- 9. ASME (American Society of Mechanical Engineers)
- 10. NEC (National Electrical Code)
- 11. UL (Underwriters Laboratory Standards)
- 12. IEEE (Institute of Electrical and Electronics Engineers, Inc.)
- 13. AWS (American Welding Society) and D1.1, Structural Welding Code.
- 14. NEC (National Electric Code)
- 15. NEMA (National Electrical Manufacturers Association)
- 16. CEMA (Conveyor Equipment Manufacturers Association)
- 17. OSHA (Occupational Safety Health Administration)

1.04 ACCEPTABLE MANUFACTURER AND MODEL / QUALITY ASSURANCE:

- A. Acceptable manufacturer shall be Enviro-Care Company FSM, or approved equal. Approval of an alternate shall follow process outlined in Article 11 of the Instructions to Bidders.

- B. Equipment shall be designed/sized/selected by the manufacturer for this specific installation meeting the performance requirements herein. Acceptable models for the perforated plate filter screen system are below, or approved equal. Manufacture shall confirm and demonstrate via submittal that the proposed models meet the performance criteria:
1. Perforated Filter Screen Model FRSIII 550 x 3075/3
 2. FSM Hydraulic Screenings Flume Model SW 300
 3. SPECO WASTECOM Shaftless Conveyor/Compactor CPS 200.
- C. Perforated Plate Filter Screen manufacturer qualifications:
1. In order to establish a quality standard for the manufacture and production of the equipment, all manufacturers shall meet the requirements listed in this section.
 2. Manufacturer shall have a minimum of ten years of experience in producing substantially similar equipment, and shall be able to show evidence of at least fifty (50) installations in satisfactory operation for at least five years.
 3. The minimum acceptable standards for the equipment shall conform to the project contract documents as outlined in the respective sections of the specifications and drawings.
 4. An officer of the Company is required to certify the proposed alternate manufacturer has completely read the specification and takes no exception; or if exceptions are taken they must be listed in the alternate equipment proposal in accordance with Section 01 25 00.
- D. Workmanship and Design:
1. The centrifuge manufacturing facility shall be ISO 9001:2015 certified.
 2. All parts of the equipment provided to be designed and manufactured for long, continuous and uninterrupted service. All materials to be used are of best quality and entirely suitable for service required.
 3. Provisions to be made for easy lubrication, adjustment or replacement of all serviceable parts. A minimum clearance of three feet around all sides of the equipment is required for proper maintenance.
 4. Centrifuge assembly shall be designed to assure easy disassembly of the unit, including removal of the rotating assembly vertically, within the space and headroom provided.
 5. The corresponding parts of multiple units if applicable shall be interchangeable.

1.05 SUBMITTALS

- A. Submittals shall conform to Section 01 33 00 of these Specifications, and shall include complete manufacturer's literature, drawings, installation instructions, operation and maintenance manuals and written warranties for all pieces of equipment and accessories.
- B. Submittals shall include:

1. Certified general arrangement drawings showing all details including materials of construction, dimensions, loads on supporting structures, and anchor bolt locations. Arrangement shall show as-built dimensions (see as-built requirements herein).
2. Shop drawings, catalog cut sheets, and other materials required to completely describe and specify the system and equipment.
3. Descriptive literature, bulletins and/or catalogs of the equipment.
4. Complete data on motors and gear reducers.
5. Complete wiring diagrams and electrical/instrumenting schematics for all control equipment to be furnished.
6. Describe the automatic adjusting cleaner brush.
7. Describe method of checking and adjusting drive chain tension.
8. Provide details of the area at the bottom of the screen to show how the screen will pick up large objects off the channel floor.
9. Provide details of the bottom of the screen that shows the method employed to prevent buildup of grit and small stones beneath the screen and to prevent wear on the screen elements.
10. Provide independent certified test data confirming screen SCR value with perforated panels of the same size as specified herewith. Testing shall confirm the percentage of all material captured by the screen as documented by the National screen evaluation facility at Chester Lee Street in England by TRPM and Northumbrian Water. The documented report of the test which shows the result of screenings capture rate (SCR) must be provided with submittals.

1.06 WARRANTY

- A. Warranty for the perforated plate filter screen system and all associated equipment and appurtenances shall extend for 12 months after start-up.
- B. Warranty shall include all parts, labor, shipping, and coatings for repairing or replacing equipment that fails during the warranty period. Defects occurring within the warranty period shall be repaired or replaced by the manufacturer at no cost to the Owner.
- C. The screen shall be unconditionally guaranteed to meet or exceed design criteria detailed in Part 2 of this specification.
- D. Lower bearing/bottom revolving guide disk with incorporated bearing shall be guaranteed for five (5) years.

1.07 PRECONSTRUCTION AS-BUILT

Prior to construction Contractor shall obtain and provide to the manufacturer as-built information required for manufacturer design/selection/supply of the equipment and appurtenances specified herein to be installed at the location shown on the Drawings. Equipment shall be manufactured to accommodate existing conditions and for installation as shown, and shall include all required appurtenances, anchors, connections, and any other needed item for a complete and operational system sized for this specific installation and installed at the location shown in the Drawings. Any modifications required to existing structures, building, or other existing features shall be included in the amount bid.

1.08 DELIVERY, STORAGE AND HANDLING:

Items to be shipped as complete assemblies except where partial disassembly is required by transportation regulations or for protection of components. Equipment shall be delivered as completely assembled as

practical to minimize field assembly. All equipment be pre-piped and pre-wired at the factory as much as practical. Contractor shall be responsible for unloading and any necessary field assembly. Contractor shall contact manufacturer for assembly requirements during bid.

1.09 SEQUENCING AND SCHEDULING:

Coordinate work with restrictions as specified in the Contract Documents. Perforated Plate Filter Screen system sequencing will require temporary bypass structures in the headworks channel which shall be included in the amount bid. See Section 01 01 00 Special Requirements and Section 01 89 00 Sequence and Limitations of Construction.

2.00 PRODUCTS

2.01 QUALITY ASSURANCE

- A. Equipment manufacturer shall be ISO 9001 certified.
- B. Perforated Filter Screen shall be fully assembled and run to confirm fit and function of the screen. A certificate of the shop run test shall be supplied to the owner prior to shipping.
- C. The Perforated Filter Screen will be shipped to the site fully assembled, if possible, and dependent upon the height of the screen. Some ancillary components may be removed to prevent damage during shipment.
- D. Shop Surface Preparation/Coating: All weldments shall be cleaned and passivated using a full dip passivation process to remove weld spatter, slag and discoloration. Bearings, electrical devices, drive and wiper chains and sprockets, motor and gear reducer shall be provided with the manufacturer's standard coating system. Screen weldments not full dipped passivated, using spray on cleaning solutions, passivating welds only or bead blasting shall not be allowed.
- E. Definitions
 - 1. Screen Height: The height between the operating floor and the top of the perforated plate screens.
 - 2. Discharge Height: The height between the operating floor and the screenings discharge.
 - 3. Head Loss: Total difference in elevation of the water level upstream of the upstream screening elements and downstream of the downstream return elements.
 - 4. Percent Blinded: Percentage of submerged area of partially blinded perforations relative to total area of non-blinded perforations.
 - 5. Maximum Differential Head: Maximum difference in elevation of the water level upstream and downstream of the upstream screening elements that the screen will experience during emergency conditions (i.e. screen fully plugged).
 - 6. Screenings Capture Rate (SCR) / Efficiency: Percentage of all material captured by the screen as documented by the National screen evaluation facility at Chester Lee Street in England by TRPM and Northumbrian Water. The documented report of the test which shows the result of screenings capture rate (SCR) must be provided with submittals.
 - 7. Screen Angle $\alpha\beta$: Angle of screen frame to maximum water level; transition angle to discharge point; incline from horizontal plane parallel with mounting floor.

2.02 PERFORMANCE REQUIREMENTS

A. Perforated Filter Screens

1. Solids will collect on a continuous belt of perforated filter panels perpendicular to the flow, elevating solids to the discharge point. The perforated filter panels shall be cleaned by means of an automatic adjusting rotating cleaner brush. Screens that do not have an automatic adjusting rotating cleaner brush shall not be allowed.
2. The perforated filter panels shall be driven by drive sprockets secured to the main drive shaft.
3. Perforated plate screens shall be designed by the manufacturer meeting the following minimum, performance requirements:

Conditions	Unit
Number of screens	1
Average flow per screen (MGD)	0.5
Peak flow per screen (MGD)	2.8
Downstream Liquid Level at Peak Flow (in)	12.0
Headloss at Peak Flow @ 0% Blinding (in)	7.9
Headloss at Peak Flow @ 30% Blinding (in)	10.9
Screen Panel Perforation Diameter (mm)	3
Channel Width (ft)	*
Channel Depth (ft)	*
Screen angle from horizontal lower section	30 degrees
Screen angle from horizontal upper section	75 degrees
Screenings discharge height from top of channel (ft)	11.4
Minimum Screenings Capture Ratio (SCR)	85%

**Contractor responsible for obtaining as-built information for manufacturer's use. See requirements herein.*

4. The minimum screening capture rate for 6 mm perforation must be 85% this result must be confirmed by the National screen evaluation facility at Chester Lee Street in England by TRPM and Northumbrian Water. The documented report of the test which shows the result of screenings capture rate (SCR) must be provided with submittals.

2.03 UTILITY REQUIREMENTS/ENVIRONMENTAL CONDITIONS

A. All moving wetted parts, all wetted parts on which moving parts ride, all filter belt components under guiding, bearing, or driving loads shall be 316 stainless steel, wear resistant heat treated, high tensile, wear resistant steel, or UHMW-PE as noted below:

1. The frame shall be minimum 4mm thick type 316 stainless steel.
2. The discharge chute, and all covers shall be type 316 stainless steel.
3. The screen and brush drive shafts shall be type 316 stainless steel.
4. The rotating deflector shall be from type 316 stainless steel.
5. The lower sprocket stub shafts shall be from type 316 stainless steel.

6. The upper and lower sprockets shall be type 316 stainless steel with only the wear area hardened.
7. The middle guide transitioning the filter panels from 30 degrees to 75 degrees is a non-revolving guide from UHMW-PE.
8. The screening elements shall be one piece curved from type 316 stainless steel and will not require upstream protection using coarse bar screens. Screens that require upstream protection shall not be permitted.
9. The heavy duty roller chain will be from type 316 stainless steel with PA6 rollers.
10. The side and bottom seals shall be replaceable contoured UHMW-PE with 316 stainless steel fasteners.
11. The screening element support rails shall be 316 stainless steel with UHMW-PE wear surface or equivalent.
12. Spray bars from shall be 316 stainless steel.
13. All fasteners shall be 316 stainless steel.
14. All other appurtenances shall be of manufacturer's standard coated material.

2.04 EQUIPMENT DESIGN FEATURES

A. General

1. The screen shall be designed to provide maximum solids filtration and thus maximize capture of debris and minimize rate of head loss increase through the screen. This shall be achieved by means of one piece perforated curved filter elements. The maximum perforated opening shall be 3 mm. The screen will be operated intermittently by means of differential head measurement.
2. The screen shall be mounted by fastening to the top of the channel and include a pivoting support arrangement to pivot the screen from the channel without dewatering the channel. The pivot will be attached to the screen frame and top of the channel to allow the screen to be pivoted above the top of the screw wash press following the removal of the inlet hopper attached to the unit. It will not be necessary to disassemble or move the compactor from its fixed position. The pivoting system shall be constructed of 316 stainless steel and complete as required to function in accordance with the specification. Routine service, repair or replacement of damaged parts, shall be possible with the screen in the channel.
3. Unit shall be designed so that maintenance of the drive mechanism can be accomplished at operating floor level. Screen elements shall be capable of removal at the operating level without taking the screens out of the channel or effecting the continuous or intermittent rotation of the screen.
4. The screen shall be factory assembled and tested prior to delivery and shall be delivered to the site fully assembled (other than the motor/reducer unit, discharge chute, and support legs). It shall be capable of being set in place and field erected by the contractor with minimal field assembly.
5. The influent screening system shall include a perforated plate screen. The perforated plate screen shall be a self-contained screening system used to capture and transport wastewater debris to the washer/compactor system.

6. Influent screening system shall be designed for both continuous or intermittent operation. The perforated plate screens shall be installed in the channel as shown on the Contract Drawings.
7. All components shall be amply proportioned for all stresses that may occur during manufacturing, transportation, erection, and operation.

B. Filter Screen

1. The one piece curved screening elements shall be minimum 1/8" thick and fixed by four fasteners to the heavy duty roller chain drive links having 7.87" pitch x 1.38" x 0.2" thick section which shall ride on 0.2-inch thick 316 stainless steel supports located on the upstream and downstream sides of the screen. Chain shall have an average ultimate design strength of 20,232 lbf (90kN). On every tenth screen panel a set of static, non-engaging 'finger' type lifters shall be attached to the lower edge of the panel, designed specifically to lift spherical and large size solids (stones, square lumber cans, bottles, rag clumps, etc.) from the bottom of the channel. Screens that use lifting ledge on top of the panel thereby preventing the removal of solids from the bottom of the channel floor will not be permitted. Screens which do not support the drive chains on the downstream side will not be approved.
2. A submerged stainless steel plate shall be provided at the base of the screen. The base of the screen shall be fitted with a rubber seal 10mm thick directly followed by a nylon brush along the full length of the filter panel to prevent ingress of stones and grit and to prevent solids bypass.
3. Two (2) upper sprockets from 3/4-inch thick type 316 stainless steel with 7.87 inch pitch. Upper sprockets shall be split to allow removal without having to remove the drive shaft.
4. Two (2) revolving 3/4-inch thick lower guides with 7.87 inch pitch. Lower revolving guide bearings shall be slide bushing from bronze with a 316 stainless steel 3.15 inch stub shaft. Complete unit sealed with stainless steel cover, O-rings and v-rings seals. Grease line from stainless steel brought to operating level. Ball or roller bearings or slide bushings made of plastic or ceramic shall not be accepted as a lower sprocket bearing.
5. The middle guide shall be stationary between the 30 and 75-degree transition section. The use of rotating sprockets/guides in this area shall not be allowed.
6. To prevent deflection, the one-piece filter elements shall have a minimum thickness of 1/8" and shall be made of curved stainless steel. This is required to insure structural integrity and smooth operation. Engaging tines, fingers or engaging elements, which can bind or jam, will not be acceptable. Filter panels that are not curved shall not be acceptable. Filter panels with a flat face inclined and a horizontal ledge shall not be allowed.
7. The screening elements are to be of the engineered curved shaped so that they can be cleaned with optimum efficiency with an automatic adjusting rotating cleaner brush. Minimum diameter of rotating cleaner brush is 450 mm. The rotation direction of the brush drive must be in the opposite direction of the belt drive.
8. The rotating cleaner brush shall have a minimum diameter of 450 mm and be self-adjusting with no manual or motorized adjuster mechanism. The motorized cleaner brush will automatically adjust as the brush wears during use. The automatic adjustment will maintain consistent cleaning efficiency at a SCR value of 85%. The distance between the cleaner brush and filter panels will be automatically controlled to ensure the distribution and magnitude of pressure is equal across the entire filter panel surface. Systems that use gas springs or struts to adjust brush shall not be permitted. Screens with rotating cleaner brushes requiring manual adjustment or adjustment with gas cylinders or a motor shall not be permitted.

9. The lifting fingers are located on each tenth filter plate. The lifting fingers must be located on the lower area of the filter element. Systems where these fingers are near the middle or top of the element are not permitted. They will be designed to remove spherical solids from the bottom of the channel, which may otherwise roll back off the screen face and accumulate thus creating a wear problem as the screen elements are moving thru the solids as they ascend on the upstream side of the screen.
10. The screening elements must be sealed against the chain by means of special knuckle joint side plates attached to each perforated plate filter element. Maximum gaps between the screen panels and side frame is 1 (or 3?) mm. These side plates must be made in Stainless steel. Simple brush systems are not permitted. This is to ensure that small items are not floated past the sides of the screening elements.
11. A rotating deflector consisting of a 316 stainless steel tube roller wiper fabricated from 3.5 inches O.D. complete with 1.75 inches diameter stainless drive steel shafts at each end supported by two-hole flange bearings and auxiliary driven by screen drive unit. The roller wiper shall turn at max 20 rpm and function to seal the gap between the filter panels and discharge chute and to direct the heavier solids removed from the screen by the revolving brush cleaner into the screenings wash press inlet hopper. The rotating deflector prevents bypassing of solids into the downstream channel. Screens supplied with a brush scraper and/or a static deflector that is not self-cleaning shall not be permitted

C. Filter Screen Panels

1. The screen filtration belt shall be provided with one piece perforated curved elements, which limits the maximum opening in any direction to the perforated opening size detailed in Paragraph 2.03.A.3-Screen Panel Perforation Diameter. This restricted opening profile prevents long thin materials from passing through the openings. The screen shall have a minimum 0.32 square feet of contact surface per square foot of wetted filtration surface area. Filter panels that are not curved shall not be acceptable. Filter panels with a flat face inclined and a horizontal ledge shall not be allowed.
2. No cleaning devices which cause trash to be pushed or dropped into the interior of the filtration belt will not be allowed.
3. The individual screening elements must not exert stresses on one another and the load transmission must be exclusively via chains. Systems which involve connecting the screen elements together with other or additional attachments are therefore not permissible because of stressing. Furthermore, the elements must not be able to overlap one another, which would create spaces in which material could collect.
4. Due to the risk of high differential levels on the screen, in the event of a power failure, excess solids load condition, mechanical breakdown etc. the screen shall be designed to withstand a maximum differential head of 5.00 ft. measured from the upstream water level to the downstream water level. The manufacturer shall provide calculations showing that it will meet this requirement. A test will be conducted at site, before the screen or screens are accepted, during which time the screen will be tested for a minimum period of two hours at the specified maximum differential head condition.
5. Should the screen fail this test, for example there is bending, bowing, buckling or other significant signs of mechanical damage then the screen shall be removed at the manufacturers cost.

6. The horizontal space between each adjoining screen panels will not exceed 1mm at any point between any adjacent panels. The screen manufacturer shall make a witnessed measurement of the screen panel adjoining spaces before acceptance at site and if more than 10% are greater than the dimension of the specified screen perforation the screen will not be accepted until the manufacturer has corrected the problem and a re-measurement as above confirms the specification has been met.
7. To control the buildup of biological slimes behind the screen panels, a 1-inch diameter internal spray water wash spray bar will be provided, manufactured from stainless steel. The spray bar will be attached in the internal space between the rotating screen panels and the spray water will be directed to wash each screen panel as the panel moves past the spray nozzles. The spray bar will supply approximately 9 gpm per ft. width of screen panel at a pressure of 40 - 45 psi. The spray orifices will be non-plugging and suitable for use with treated effluent water. A minimum 1" NPT connection will be located on one side of the screen frame above the operating floor level and the water supply connection will include an inline strainer, manual operated gate valve, and solenoid valve suitable for attaching to the 1" NPT connection. Systems that require spray bars to assist with removing screenings from the filter panels shall not be allowed. The nozzle system for cleaning the belt must be located after the cleaning by the brush. Systems with a spray bar in front of the brush are not permitted.

D. Chain and Sprockets

1. The filter panel drive chains shall be equal in pitch to the upper and lower drive sprockets.
2. The chain for the perforated filter panels shall be roller type chain and be from material as per Paragraph 2.05.A.9. Chain shall have a maximum design operating force of 20,232 lbf. Chain shall not require lubrication.
3. Each screen shall be provided with two identical drive sprockets from material as per Paragraph 2.05.A.6. Sprocket pitch and width shall match the roller chain – 7.87-inches. The sprockets shall be mounted on a drive shaft from material as per Paragraph 2.05.A.3 mounted between grease-able bearings mounted on the external side of the frame.
4. Each screen shall be provided with a middle transition guide from material as per Paragraph 2.05.A.7. This guide shall be located on the tension side between the 30 and 75-degree transition section.
5. Chain drive shaft bearings shall be four-hole flange mounted to a stainless steel plate. The bearings shall be grease lubricated. Chain tension adjustment is achieved via the take up screws attached to the flanged mounting plate. The take screw shall be an acme thread type from type 18-8 stainless steel. The bearing casing shall be made of paint coated cast iron. Units using threaded rod shall not be allowed.
6. Chain guides shall be secured to the screen frame for the full height of travel. A guide track shall also be located at the bottom of screen to allow the chain to travel from a downward to an upward direction. The chain guides shall accurately guide the chain and filter panels. The chain guide tracks shall from stainless steel.

E. Screen Drive Mechanism

1. Motor: 1.5 HP 1800/900 rpm TEFC-XP (Class I, Division 1, Group D) geardrive inverter duty motor suitable for 460/3/60 electrical supply. Overload protection shall be provided by a true power monitor electrical overload device that senses the motor power factor.

2. Gear Reducer:
 - a. Helical Worm type from SEW.
 - b. Hollow, shaft type.
 - c. Anti-friction bearings.
 - d. AGMA I rating.
 3. All drive components shall be designed to operate the screen continuously under a calculated load resulting from the differential water level between the upstream and downstream sides of the screen.
 4. Minimum filter panel speed shall be 10 fpm, maximum 23 fpm.
- F. Brush Drive Mechanism
1. Motor: 2.0 HP 1760 rpm TEFC-XP (Class I, Division 1, Group D) geared motor suitable for 460/3/60 electrical supply.
 2. Gear Reducer:
 - e. Helical Worm type from SEW.
 - f. Hollow, shaft type.
 - g. Anti-friction bearings.
 - h. AGMA I rating.
- G. Rotating Deflector Drive Mechanism:
1. Auxiliary driven from Screen drive. Screens that require a third motor for the rotary deflector shall not be allowed.
- H. Discharge Chute/Hood:
1. A discharge chute/hood shall be provided that fully encloses the discharge section of the screen. The upper section of the discharge chute/hood shall be hinged to allow complete access the screen cleaner brush. The hinged hood shall be secured with quick closing clamps and supplied with two (2) gas cylinders from stainless steel to aid opening and closing
 2. Discharge chute shall be from type 316 stainless steel.
 3. Each screen discharge chute/hood shall direct screenings directly to the compactor or other device. Outlet shall extend down to the inlet of the compactor and shall be designed to match the screenings compactor inlet hopper with no water leaking or screenings dropping to the floor.
- I. Frame Enclosures / Covers
1. The screen shall be provided with easily removable, sufficiently stiffened covers made of 18 gauge 316 stainless steel plates with edges on all sides.
 2. Covers shall be provided on the upstream and downstream portion of the screen above the operating floor

2.05 ELECTRICAL CONTROLS AND DEVICES

- A. Control Panel: 480 volt primary control panel shall be provided with a type 316, stainless steel, NEMA 4X enclosure. Panel shall be suitable for wall mounting with the following electrical components to provide proper operation of the equipment.
1. Main disconnect with through door interlock handle.
 2. Step down control transformer.
 3. Branch circuit protection.
 4. Screen two speed motor starter.
 5. Brush motor starters with overloads.
 6. Power monitors for screen two speed motor overtorque/overload protection.
 7. Emergency stop pushbutton.
 8. Hand-Off-Auto selector switches for screen and brush drive.
 9. Fast-Off-Slow switch for each screen drive motor.
 10. Open – Close – Auto switch for screen wash water solenoid valve.
 11. Power monitor shall provide overload protection for screen drive by sensing motor power factor.
 12. Hour meter for each motor.
 13. Control power on, run and fault indicating lights.
 14. Alarm reset pushbutton.
 15. Programmable relay to control screen control logic functions.
 16. Run and alarm auxiliary contacts for use by the customer.
 17. UL label.
- B. Local Emergency Stop Pushbutton: A local emergency stop pushbutton station will be provided in a NEMA 7 enclosure for field mounting at the screen unit.
- C. Ultrasonic level sensor
1. Ultrasonic Level Controller: A 120V differential level controller shall be provided in a windowed NEMA 4X polycarbonate enclosure suitable for wall mounting, to receive and interpret a 4-20mA scaled signal from an upstream and downstream transducer. The controller shall have 5 internal relays and provide an LCD display.
 2. Ultrasonic Level Transducer: Two (2) ultrasonic level transducers shall be provided with type 316 stainless steel mounting brackets and expansion anchors. Each sensor shall have an ETFE housing with an integral sensor to provide compensation for acoustic variations due to temperature. Each sensor shall have a range of 1-33 ft and be supplied with a 33 ft integral cable. Sensor shall be suitable for installation in a Class 1, Division 1, Group D area.

2.06 OPERATION, MONITORING, AND CONTROL

- A. Screen and Brush Hand Operation: In HAND position the operator shall be able to run the screen or brush assembly by selecting the respective HOA selector switch. Turning the screen selector switch to Off will stop the unit. Screen drive motor is interlocked with the brush motor. Brush motor must be on if the screen is in operation.
- B. Screen Automatic Operation: When the Screen and Brush are in AUTO position the screen shall be controlled by the water level sensors. Screen operation shall be started when the water level sensors monitor a certain water level difference, when the sensor senses high upstream water level, high differential, or when a certain time has passed since the last operation of the screen. Screen operation shall be stopped with an adjustable delay time after the water difference is below a certain value and after the sensor reads the correct water level, or after a certain run time has expired (if operation was started by timer).
- C. Wash water solenoid valve Operation: In HAND position the wash water solenoid valve will open. In the CLOSE position the wash water solenoid valve will close.
- D. Wash Water Automatic Operation. The wash water solenoid valve will open and close via a repeat cycle timer whenever the screen is in operation.
- E. Fault Conditions:
 - 1. Excessive motor power will trip the starter overload relays, immediately stop the drive or brush motor, and illuminate the alarm indicating light. This fault must be reset by depressing the associated motor starter overload reset internal to the control panel.
 - 2. Momentary drive high torque will trip the screen motor power monitor, immediately stopping the screen drive motor, and illuminate the alarm indicating light. Pushing the reset pushbutton will reset this fault.

2.07 ANCHORAGE AND FASTENERS

- A. Anchor Bolts: All anchor bolts shall be a minimum of 1/2 inch diameter and made of type 316 stainless steel. The equipment supplier shall furnish all anchor bolts, nuts, and washers required for the equipment.
- B. Fasteners: All fasteners shall be type 316 stainless steel. The equipment supplier shall furnish all fasteners required for the assembly of the equipment.

2.08 SPARE PARTS

- A. The following minimum spare parts shall be provided for the perforated filter screen (total) –
 - 1. Three (3) filter panels.
 - 2. One (1) complete set of replacement cleaner brush elements.
 - 3. Five (5) feet of chain with one (1) master link.
- B. Manufacturer shall recommend any additional spare parts deemed necessary based on experience with the screen in similar applications.

3.00 EXECUTION

3.01 PREPARATION

- A. Channel and building shall be prepared for installation of the equipment in accordance with manufacturers recommendations and as needed for installation and for a fully operation system. The mounting points of the channel shall be level and parallel and of proper size.
- B. Contractor shall verify all dimension in the field to ensure compliance of equipment dimensions with the drawings. See as-built requirements in section 1.00 of this specification

3.02 FACTORY TEST:

- A. Manufacturer shall conduct in-factory functional testing of assembled unit
- B. Manufacturer shall submit protocol for factory test for owner review.
- C. Manufacturer to submit factory test results report for review by Owner prior to shipment of the assembled unit to the jobsite.
- D. Test shall include the following at the minimum.
 - 1. Power
 - 2. Test rotation of all motors and drive units
 - 3. Simulate operation conditions and modes to confirm function
 - 4. Simulate all alarm input conditions to verify appropriate alarm indication and shutdown functions
- E. Witnessed Testing:
 - 1. Manufacturer to provide four weeks advance notice to Owner of factory test.
 - 2. Manufacturer shall allow Owner, at Owners option and cost, to visit suppliers factory test.

3.03 DELIVERY OF EQUIPMENT:

- A. Contractor shall coordinate work herein with construction sequencing and phasing requirements included in the Contract Documents.
- B. Equipment supplied under this section shall not to be delivered to the site until construction has progressed to the point where installation may properly commence.
- C. All equipment shall be protected and shall be in accordance with the Manufacturer's recommendations.
- D. Contractor shall replace any equipment damaged after receipt of equipment at no cost to the Owner.

3.04 INSTALLATION:

- A. Installation shall be in strict accordance with the Manufacturer's recommendations and instructions and shall be in accordance with the specifications herein and the Drawings. Installation shall include all equipment, labor, materials, connections, or any other item needed for a complete and operational perforated plate filter screen.

- B. All equipment, components, piping and appurtenances shall be installed true to alignment and rigidly supported. Any damage caused by the negligence of the Contractor to the above items shall be repaired or replaced by the Contractor to its original condition.
- C. Interconnecting piping supplied by the Contractor to be hydrostatically tested by the Contractor.
- D. The screen system Manufacturer's representative to be present during placement and connection of the unit to instruct and observe installation.
- E. Manufacturer's representative to inspect the installation prior to startup in order to verify that the equipment has been properly installed.
- F. Manufacturer's representative shall calibrate the equipment with the Owner's operator present after installation prior to startup.
- G. All products, accessories, and appurtenances shall be installed in accordance with manufacturer's instructions and approved submittals.
- H. The Contractor shall provide all hardware and accessories required for installation.
- I. Anchor bolts and all needed connectors are to be sized by Manufacturer and provided by Contractor.

3.05 MANUFACTURER'S ASSISTANCE:

- A. Manufacturer shall provide installation instruction manuals for Contractor's assistance at least 30 days prior to shipment of factory assembled treatment units
- B. Manufacturer shall provide assistance regarding handling, assembly and installation requirements for complete installation by the Contractor.
- C. Manufacturer shall provide assistance as needed for construction of the perforated plate filter screen system.
- D. Contractor shall verify all equipment is installed in accordance with the manufacturer's recommendations and literature and the Drawings.

3.06 FIELD QUALITY CONTROL

- A. Service:
 - 1. Qualified service personnel must be available on a 24 hours a day basis
 - 2. The personnel must be completely familiar with the items supplied so as to return inoperative equipment to service in the shortest possible time
 - 3. The pre-qualification information is to include the following:
 - a. Name, educational background and years of service experience for all service personnel
- B. Tests:

1. Field testing and checking of installation to be approved by Manufacturer's field representative
2. Test under full load conditions
3. Verify that all control system functions, including alarms, perform as specified
4. Any spare parts furnished as specified but used during startup must be replaced prior to final acceptance
5. Manufacturer's field representative to perform field test
6. An independent lab is required to test all samples and the Centrifuge Company is to pay for this while the Owner selects the lab.
7. If equipment fails to meet performance specifications, the manufacturer, at no cost to the owner, shall modify, replace, and otherwise do whatever is necessary to provide equipment that will pass the equipment testing specification.

C. Manufacturers Field Services:

1. Qualified factory-trained representative to provide startup and operator training services. Representative to be available within two (2) weeks of request for services. Representative to provide following services:
 - a. Equipment installation review and certification of proper installation: Provide one (1) trip; minimum of eight (8) hours onsite for initial visit to checkout installation and verify that centrifuge system is ready to operate
 - b. Startup and operator training: Provide one (1) trip of minimum two (2), 8-hour days to provide classroom training of operating personnel in the operation of centrifuge system and to provide "hands-on" training for operation of equipment
 - c. Six (6) month performance review and post startup training: One (1) trip of 8-hours minimum to make operating adjustments and provide additional instruction to Owners personnel within 6 months after final acceptance of equipment

3.07 LIFTING AND MOVING EQUIPMENT

- A. Lifting points shall be identified on all Enviro-Care equipment. A crane of sufficient capacity must be on site for unloading the equipment from the truck and placing in the channel for installation.

** End of Section **

1.00 GENERAL

1.01 DESCRIPTION OF WORK

- A. Contractor shall provide and install a liquid polymer blending and feed system in the tertiary treatment building to work in conjunction with the tertiary Automatic Backwash Discfilter. The polymer blending and feed equipment shall be provided by the supplier of the Automatic Backwash Discfilter, who shall be responsible for coordinating scope of supply of the tertiary filtration system, and all appurtenances listed in section 46 61 33 as well as integrating the filters and all appurtenances into a complete and operable system.

1.02 RELATED WORK

- A. Section 01 33 00 – Submittals Procedure
- B. Section 01 60 00 – Product Requirements
- C. Section 01 75 00 – Testing, Start-Up, and Training
- D. Section 46 61 33 – Automatic Backwash Discfilters
- E. Division 26 - Electrical
- F. Section 40 05 53 - Identification for Process Piping and Equipment
- G. Section 40 05 90 – Common Work Requirements for Process Equipment

1.03 REFERENCE STANDARDS

- A. The work in this section is subject to the requirements of applicable portions of the following standards:
 - 1. Hydraulic Institute
 - 2. ANSI – American National Standards Institute
 - 3. ASTM – American Society for Testing and Materials
 - a. ASTM A48 - Standard Specification for Gray Iron Castings
 - 4. NEMA – National Electrical Manufacturers Association
 - 5. UL - Underwriters Laboratories

1.04 SUBMITTALS

- A. Furnish submittals in accordance with Section 01 33 00 - Submittal Procedures.
- B. Warranty as specified herein.

- C. Operation and Maintenance manuals shall be provided in accordance with Section 01 33 00 - Submittal Procedures.

1.05 MANUFACTURER

- A. The polymer feed system and accessories shall be furnished by a single manufacturer who is fully experienced, reputable, and qualified in the manufacture of the equipment to be furnished. The equipment shall be designed and constructed in accordance with normally accepted practice and methods.
- B. The polymer feed system shall meet all requirements of the filter system supplier to assure a complete and operable tertiary filtration system to meet the performance requirements of specification section 46 61 33.
- C. The polymer feed system shall be manufactured by Acrison or approved equal.

1.06 BIDDING

- A. The cost of the liquid polymer blending and feed equipment shall be included in the lump sum bid price for Filtration Building.

1.07 WARRANTY

- A. Manufacturer shall warrant the pumps to be free of defects in materials and workmanship for a period of one (1) year from the Date of Substantial Completion and in accordance with the General Conditions.

2.00 PRODUCTS

2.01 LIQUID POLYMER SYSTEM

- A. Description

A liquid polymer batch system as shown on the plans and specified hereafter. The system shall be designed with the capability for dispensing and wetting up to 15 gallons per hour of liquid polymer at a 0.3 percent solution.

- B. Components

The liquid polymer batch system, including the mixing and aging tanks, shall be furnished by a single supplier, with all manufacturing and assembly of the equipment and controls carried out in the supplier's facilities.

- C. Components

- 1. Liquid Polymer Blending Skid: A pump skid containing a Dispersion-Injector, pressure switch, pressure gauge, solenoid valve, rotameter and progressive cavity pump shall be provided for blending liquid polymer with water, and directing the solution immediately to the mix tank.

The skid shall be constructed of 304 stainless steel. The pump shall have a cast iron housing, Viton stator and stainless steel rotor, driven by a direct coupled 1/2 HP, TEFC motor with variable speed control. The controller shall be mounted in the main control panel described herein.

All items shall be pre-wired to a NEMA 4X junction box.

2. Mixing Tank: The mixing tank shall be rectangular in shape, and have a capacity of 100 gallons. The tank shall be constructed of 11 gauge, 304 stainless steel, complete with a (full) cover on which the level transmitter, and a slow speed mixer shall be installed. Plastic or fiberglass tanks will not be acceptable. Open-top tanks will also not be considered acceptable.
3. Mixer: The mixing tank shall be complete with a 1/2 HP, slow speed mechanical mixer. The mixer impeller speed shall not exceed 400 RPM and the impeller shall be positioned no less than one and one half impeller diameters from the bottom of the tank. The mixer assembly shall include an angle riser support, right angle gear-reducer, and a TEFC motor. The impeller and shaft shall be 316 stainless steel. The unit shall be heavy-duty in construction and capable of operation at varying tank levels. The mixer shaft diameter shall be 7/8 inch minimum.
4. Transfer Valve: The transfer valve shall be sized for quick gravity transfer of the mixed polymer to the aging tank on a demand signal from the level transmitter in the aging tank. The valve shall be motor operated with a manual over-ride and constructed of 316 stainless steel. The valve shall be mounted on the side of the tank for easy access, and to minimize the possibility of clogging from tramp material.
5. Mixing Tank Support: A heavy-duty steel structure shall be provided to support the mixing tank assembly directly above the aging tank. Systems that have the mix tank supported directly on top of the age tank cover will not be acceptable.
6. Aging Tank: The aging tank shall be rectangular in shape and have a capacity of 200 gallons. The tank shall be 11 gauge, 304 stainless steel, furnished with a (full) gasketed cover on which the level transmitter shall be mounted. Labyrinth baffles shall be provided to promote a plug flow pattern within the tank to optimize polymer detention. Plastic or fiberglass tanks will not be acceptable. Open-top tanks will also not be acceptable.
7. Ultrasonic Level Transmitters: Ultrasonic level transmitters shall be mounted on both the mix tank cover and the age tank cover to provide complete control of the preparation system operation, including level-alarm indication, and to provide a continuous display of the level in each tank on the control panel touchscreen display. The control and alarm set-points shall also be settable through this display. The ultrasonic level transmitters shall have a range of 0.033 to 6 feet, a resolution of 0.03 inches, 4 to 20 mA output, and simple push-button calibration. Operating frequency shall be 148 kHz. Level transmitters shall not extend more than 5 inches from the top of the tank covers. Level sensing devices that come into physical contact with the polymer solution will not be acceptable.

8. Progressive Cavity Type Made-Down Polymer Metering Pumps: Progressive cavity metering pump skids shall be supplied, in accordance with 2.13 of this specification, for metering of made-down polymer from the liquid polymer processing system aging tank to the coagulation and flocculation process. Controls for the made-down polymer metering pumps shall be as specified in 2.13 of this specification and shall be separate from those for the liquid polymer processing system. The made-down polymer metering pumps shall be sized and supplied by the Discfilter supplier and not by the liquid polymer processing system manufacturer.
9. Drum Mixer: A bung-entering mixer for use with 55-gal drums shall be supplied to mix the liquid polymer for 15 minutes prior to use in the coagulation/flocculation process, as well as 15 minutes of mixing once per week, should the 55 gal drum not be exhausted during that time period. The mixer shaft and impeller shall be 304 stainless steel. The mixer motor shall be TEFC, and shall have single phase, 60 Hz, 115 V power requirements. The mixer shall be gear driven and designed for mixing shear sensitive chemicals. The Discfilter supplier, and not the liquid polymer processing system manufacturer, shall supply the drum mixer.

D. Controls

1. Control Panel: The polymer preparation module shall include a NEMA 4 control panel to automatically operate the entire preparation module (system) and all components thereof.
 - a. The control panel shall include an Allen-Bradley Micrologix 1100 PLC with Ethernet connectivity, as standard. The panel shall be equipped with an unmanaged four port industrial Ethernet switch.
 - b. Operator interface shall be an 10" Allen-Bradley PanelView Plus Compact, with 640 x 480 resolution, and a TFT 18 bit color display.
 - c. The panel shall also include a main disconnect switch and an emergency stop push-button.
 - d. Should the system experience a loss-of-power, the PLC shall remember where in the sequence of operation the polymer preparation module was interrupted, and continue from that point when power is restored, and the start button pressed.
 - e. Magnetic starters, providing overload protection, shall be provided for each motor. Starters shall be mounted in the same control panel by the equipment supplier and wired to their respective motors to the greatest extent possible.
 - f. Power supply for motors shall be 230/3/60 or 480/3/60. A suitable transformer shall be included to step voltage down to 115 volts for control functions.
 - g. The color touchscreen operator interface shall provide the following capabilities at a minimum:
 - h. "Process" screen, showing on/open status of all components during system operation.

- i. Continuous level displays for both the mixing and aging tanks.
- j. Resettable batch counter.
- k. Alarm acknowledge and reset buttons.
- l. Password protection.
- m. "Alarm" screen showing all possible alarms, noting which alarms are currently present.
- n. Alarm 'history' screen.
- o. "Timers" screen, allowing the operator to set various system delay timers.
- p. "Switches" screen, including H/O/A switches for all major components.
- q. Local/Remote capability.
- r. "Levels" screen, allowing the operator to set mixing and aging tank control and alarm levels.
- s. Screen contrast adjustment.
- t. Backlight-off screen saver.

E. Quality Assurance

The polymer feed system and accessories shall be furnished by a single manufacturer who is fully experienced, reputable, and qualified in the manufacture of the equipment to be furnished. The equipment shall be designed and constructed in accordance with normally accepted practice and methods.

2.02 POLYMER METERING PUMPS

A. Acceptable Manufacturers

The dilute polymer feed skid system described in this section shall contain progressing cavity pumps as manufactured by Moyno or Seepex Pumps or equal (approval required). For another manufacturer to be determined acceptable for providing progressing cavity pumps on this project, it must supply references of five separate, substantially similar installations with contact names and phone numbers. Referenced installations must be for the same chemicals required in this specification and have been in satisfactory operation for a minimum of 2 years.

- B. The dilute polymer feed skid shall be self-contained and designed to feed required concentrations of polymer. Each polymer feed skid shall include one single stage progressing cavity pumps. The progressing cavity pumps shall be capable of both manual and automatic control. Automatic control shall be accomplished by following a 4-20 mA control signal through a controller to be provided by the skid or pump manufacturer. The metering pump skid will be completely assembled, wired, and pre-tested prior to delivery to the job site.

C. Chemical Pump Metering Skid:

The polymer feed skid shall be constructed of heavy duty corrosion resistant material with adequate supports for all equipment and piping. Forklift truck cut outs to be provided. Each progressing cavity pump shall be mounted onto an individual baseplate as a pump unit. Each pump unit shall contain a single stage progressing cavity pump with independently mounted gear reducer if needed and NEMA motor. Each pump unit shall be shimmed, aligned, and built independently of the structural skid.

Polymer feed pump system piping shall include at a minimum (1) calibration column per pump.

All piping shall be schedule 80 PVC and assembled by the skid manufacturer. All piping shall be socket-welded using standard procedures. Where threaded connections need to be made the manufacturer will utilize Teflon tape and a suitable thread sealant.

D. Chemical Metering Pump:

1. Pump Type: Positive displacement progressive cavity pump. Pump shall be capable of handling high viscosity polymer.
2. Provide manual speed adjustment, 0-100%, in 1% increments. Provide ability to adjust speed while pump is operating.
3. Motor: Variable Speed Motor with Controller. TEFC/TENV Enclosure.
4. Motor Controller: NEMA 4X Enclosure. VFD shall be Allen Bradley
5. Materials
6. Housing: Cast Iron or 316 Stainless Steel
7. Bearings: Grease Lubricated Type
8. PTFE Packing or Mechanical Seal
9. Rotor and Drive Train: Chrome plated hardened alloy or 316 Stainless Steel
10. Stator: 70 dM Nitrile or Viton
11. The pumps shall have the following Remote Control Outputs (to Kruger PLC)
 - a. Dry contact for Auto Status
 - b. Dry contact for Run Status
 - c. Dry contact for Fail Status
12. The pumps shall have the following Remote Control Inputs (from Kruger PLC)
 - a. Dry contact for Start/Stop Command

b. Dry contact for Speed Command

E. Accessories:

Calibration Cylinders: Calibration cylinders shall be provided and installed in the chemical supply piping. The cylinder shall be vented back to the chemical supply. The calibration cylinder shall be sized for a **1-minute** draw down at maximum pumping rate.

Materials: Cylinder body shall be clear PVC. End Caps shall be PVC.

F. Controls:

1. Based on pump selection, if required, each skid shall be provided with a skid mounted control panel for all pumps or shall be provided with a skid-mounted termination box.
2. Provide main disconnect mounted in control panel (not applicable for skids with terminal box designs or where controls are integral to the pump housing) or as integral part of controller unit.
3. Utilize common terminal strip for electrical connections.
4. Provide terminals for single 120V 1 phase input or 460V 3 phase input.
5. Provide a hand/off/auto selector switch mounted on the control panel or terminal box.
6. Provide auxiliary contact for remote indication of hand/off/auto selection
7. In Auto, the pump shall be frequency adjusted by 4-20 mA flow signal through a controller provided by the skid or pump manufacturer.
8. All enclosures shall be rated NEMA 4. When applicable all switches, indicator lights, and knobs shall be mounted on the termination box or local panel door.

G. Pump Design Criteria:

Type of application	Polymer Dosing
No. Pumps Required	One (1) duty + one (1) standby
Pump Capacity Range (gph)	0.25 - 56
Pump Discharge Pressure @ Capacity (psi)	30
Polymer Dosage Range (mg/L)	0.1 – 2.0
Prepared Polymer Concentration (%)	0.1 – 0.3
Secondary Dilution Water Capacity (gph)	0 - 600

3.00 PRODUCTS

3.01 LIQUID POLYMER SYSTEM

A. Contractor shall install the equipment specified herein in accordance with the Manufacturer's recommendations, and drawings.

- B. The skid shall include nameplates and tags for the pumps as specified in Section 40 05 53 - Identification for Process Piping and Equipment.
- C. Manufacturer's representative provide services during installation, inspect the installation, and provide a Certification of Installation as specified in Specification Section 01 75 00, Testing, Start-Up, and Training.

3.02 TESTING

- A. On-site testing shall comply with the requirements of Section, Equipment Testing, Start-Up, and Training. Pumps shall be tested on specified fluid chemical solution.
- B. Manufacturer's qualified service representative shall provide a minimum of eight (8) hours of on-site testing of the equipment specified herein.
- C. Manufacturer's qualified service representative shall certify the installation and on-site testing in accordance with Section, Testing, Start-Up, and Training.

3.03 TRAINING

- A. Manufacturer's qualified service representative shall provide a minimum of four (4) hours of training of the Owner's staff for operation and maintenance of the pumps.
- B. Training shall meet the requirements of Section 01 75 00, Testing, Start-Up, and Training.

****END OF SECTION****

1.00 GENERAL

1.01 DESCRIPTION OF WORK

- A. Contractor shall supply six (6) chemical metering pumps, arranged as three (3) duplex pump skids, each fully self-contained and pre-plumbed and pre-wired to the extent possible to expedite installation and startup.
1. Coagulant metering skid no. 1 (Coag-1) will consist of two pumps (P-AL-1A and P-AL-1B) arranged to feed coagulant from the main coagulant storage tank in the final treatment building to piping conveying the coagulant to clarifier #3 influent piping.
 2. Coagulant metering skid no. 2 (Coag-2) will consist of two pumps (P-AL-2A and P-AL-2B) arranged to feed coagulant from the main coagulant storage tank in the final treatment building to the injection point in the rapid mix tank inlet line. Final piping and injection arrangement shall be as recommended by the filter system manufacturer, with approval by engineer.
 3. Alkalinity metering skid no. 3 (alkalinity) will consist of two pumps (P-CA-1A and P-CA-1B) arranged to feed supplemental alkalinity, as 25% to 50% sodium hydroxide solution from the main alkalinity storage tank in the final treatment building to operator selectable (by manual valve) injection points in the tertiary treatment train. FILTER SYSTEM MANUFACTURER SHALL RECOMMEND A MINIMUM OF THREE LOCATIONS FOR POSSIBLE ALKALINITY SUPPLEMENTATION WITHIN THE TERTIARY TREATMENT TRAIN.
 4. Work covered by this section consists of furnishing all labor, materials, and equipment required to supply, install, and test the pumps as specified in this section. The scope of work shall also include delivery, inspection, certification of installation, functional testing, startup, and job site training.
- B. Chemical metering systems, including pumps and all skid-mounted equipment, are to be provided by the Automatic Backwash Discfilter Supplier. The Discfilter manufacturer shall assume responsibility of coordinating operation of the Discfilter and all appurtenance equipment including chemical metering systems described in this section.

1.02 RELATED WORK

- A. Section 01 33 00 – Submittals Procedure
- B. Section 01 60 00 – Product Requirements
- C. Section 01 75 00 – Testing, Start-Up, and Training
- D. Section 46 61 33 – Automatic Backwash Discfilters
- E. Division 26 - Electrical
- F. Section 40 05 53 - Identification for Process Piping and Equipment

G. Section 40 05 90 – Common Work Requirements for Process Equipment

1.03 REFERENCE STANDARDS

The work in this section is subject to the requirements of applicable portions of the following standards:

1. Hydraulic Institute
2. ANSI – American National Standards Institute
3. ASTM – American Society for Testing and Materials
 - a. ASTM A48 - Standard Specification for Gray Iron Castings
4. NEMA – National Electrical Manufacturers Association
5. UL - Underwriters Laboratories

1.04 SUBMITTALS

- A. Furnish submittals in accordance with Section 01 33 00 - Submittal Procedures.
- B. Performance curves showing flow in GPH, pressure in PSI, pump speed in RPM, and required motor horsepower from 0 GPM to 110 percent of design capacity. The curves shall be provided for 15 RPM increments.
- C. Warranty as specified herein.
- D. Operation and Maintenance manuals shall be provided in accordance with Section 01 33 00 - Submittal Procedures.

1.05 MANUFACTURER

- A. The Pump Manufacturer shall be of established good reputation regularly engaged in the fabrication of such equipment. Unless otherwise noted, any equipment offered shall be current modifications which have been in successful regular operation under comparable conditions.
- B. The chemical metering pump skid systems of this section shall be manufactured by ProMinent Fluid Controls, Grundfos Group, or equal. For another manufacturer to be determined acceptable for providing diaphragm chemical metering skids on this project, it must supply references of five separate, substantially similar installations with contact names and phone numbers. Referenced installations must be for the same chemicals required in this specification and have been in satisfactory operation for a minimum of 2 years.
- C. All pumps shall be by a single manufacturer.
- D. Manufacturer shall have a parts warehousing facility and persons qualified in problem troubleshooting and repair of pumps permanently located within 300 mile radius of the Owner.

1.06 BIDDING

- A. The cost of the pumps shall be included in the lump sum bid price for Filtration Building.

1.07 WARRANTY

- A. Manufacturer shall warrant the pumps to be free of defects in materials and workmanship for a period of one (1) year from the Date of Substantial Completion and in accordance with the General Conditions.

2.00 PRODUCTS

2.01 METERING PUMP SKIDS

- A. Each chemical metering skid shall be self-contained and designed to feed required amounts of Coagulant or other designated chemical according to paragraph 1.01 A and 2.02 G. Each chemical metering skid shall include (2) simplex head chemical metering pumps. The metering pumps shall be capable of both manual and automatic control. Automatic control shall be accomplished by following a 4-20 mA control signal through a controller provided by the skid or pump manufacturer. The metering pump skid will be completely assembled, wired, and pre-tested prior to delivery to the job site.
- B. The chemical metering skid shall be constructed of fusion welded, black uv-protected polypropylene sheets, or ½” welded HDPE, with adequate supports for all equipment and piping. Forklift truck cut outs to be provided. The base will have a metal mounting plate and a polypropylene top plate.
- C. Chemical metering pump system piping shall include: one (1) Y-Strainer for coagulant feed located in the suction header piping, (1) pressure relief valve, one (1) check valve per pump, one (1) pulsation dampener, one (1) pressure gauge with diaphragm seal, one (1) back pressure valve on each discharge point, one (1) calibration cylinder and all required piping, valves, supports, and flushing ports. All piping shall include isolation valves and unions for all serviceable components.
- D. All piping shall be schedule 80 PVC and assembled by the skid manufacturer. All piping shall be socket-welded using standard procedures. Where threaded connections need to be made the manufacturer will utilize Teflon tape and a suitable thread sealant.

2.02 PUMP CONSTRUCTION:

A. Pump:

1. Pump Type: Positive displacement mechanically actuated simplex head diaphragm pump. Suction and discharge strokes shall be controlled by single ball check valves. Check valves must be interchangeable.
2. Provide manual stroke length adjustment, 0-100%, in 1% increments.
 - a. Provide ability to adjust stroke while pump is operating.

- b. For microprocessor driven pumps, stroke length may be adjusted automatically by the microprocessor.
- 3. Drive:
 - a. Variable Speed Motor with Controller
 - b. IP65/NEMA 4X Enclosure
- 4. Materials
 - a. Diaphragm: Steel Core, Nylon Reinforced Teflon Faced EPDM
 - b. Valve Ball: Aluminum Oxide Ceramic
 - c. Valve Body: PVDF (Kynar)/PVC
 - d. Check Valve Seal: PTFE/PVC
 - e. Other Wetted Parts: PVDF/PVC
 - f. Reciprocating Shaft: Steel
 - g. Housing: Cast Aluminum inner housing with either Glass-filled Luranyl or Acrylic Resin coated outer housing.
- 5. The pumps shall have the following Remote Control Outputs (To Kruger PLC):
 - a. Dry contact for L-O-R position
 - b. Dry contact for Run Status
 - c. Dry contact for Fail Status
- 6. The pumps shall have the following Remote Control Inputs (From Kruger PLC):
 - a. Dry contact for Start/Stop Command
 - b. Dry contact for Speed Command

2.03 ACCESSORIES

A. Calibration Cylinders:

- 1. Calibration cylinders shall be provided and installed in the chemical supply piping. The cylinder shall be vented back to the chemical supply. The calibration cylinder shall be sized for a 1-minute draw down at maximum pumping rate.
- 2. Materials

- a. Cylinder Body: Clear PVC
- b. End Caps: PVC

2.04 CHECK VALVES:

- A. Provide in-line vertically mounted check valve on discharge side of each pump
- B. Materials:
 - 1. Body: PVC
 - 2. Seals: FPM or Viton or EPDM
 - 3. Sized to match line size

2.05 PULSATION DAMPENER (AS REQUIRED):

- A. Type: Bladder/bellows type dampener with dry side pre-charged with air. Pressure gauge on dry side of bladder/bellows provides indication of pre-charge pressure. Unit can be disassembled for removal and replacement of bladder/bellows. Valve on dry side allows for air recharge after servicing. The pulsation dampener shall be sized per the manufacturer's recommendations.
- B. Materials
 - 1. Body: PVC
 - 2. Bladder: Viton

2.06 PRESSURE RELIEF VALVE:

- A. Provide in-line pressure relief valve on the discharge side of each pump head. The relief side of the valve shall be plumbed to the supply side of each metering pump.
- B. Materials:
 - 1. Body: PVC
 - 2. Diaphragm: Teflon-faced EPDM
 - 3. Sized to match line size
 - 4. Relief Pressure: 0 to 150 PSI adjustable, factory set at 70 PSI

2.07 BACKPRESSURE VALVES:

- A. Provide in-line backpressure valve(s) on each dischargepoint.
- B. Materials:

1. Body: PVC
2. Diaphragm: Teflon faced EPDM
3. Sized to match line size
4. Backpressure Provided: 0 to 150 PSI adjustable, factory set at 60 PSI

2.08 CONTROLS:

- A. Each skid shall be provided with a skid mounted control panel for both pumps, or shall be provided with a skid-mounted termination box with number of power receptacles matching number of pumps.
- B. Provide main disconnect mounted in control panel (not applicable for skids with terminal box designs.)
- C. Utilize common terminal strip for electrical connections.
- D. Provide terminals for single 120V 1 phase input.
- E. All internal skid wiring to be terminated in NEMA 4X control panel or NEMA 4X terminal box prior to shipment. Required external power sources and control connections to be provided by installing contractor.
- F. Provide a hand/off/auto selector switch mounted on the control panel. For microprocessor driven pumps, hand/off/auto selection is via pump keypad.
- G. Provide auxiliary contact for remote indication of hand/off/auto selection.
- H. Provide Running and Fail indicating lights for each pump.
- I. In Hand, the pump stroke frequency shall be manually adjusted with a manual stroke adjustment potentiometer. For microprocessor driven pumps, stroke adjustment may take place via pump keypad, or may be adjusted automatically by the microprocessor.
- J. In Auto, the pump shall be frequency adjusted by 4-20 mA signal through a controller provided by the skid or pump manufacturer.
- K. In hand, motor speed adjustments shall take place via the local panel or motor controller keypad or pump keypad for microprocessor driven pumps.
- L. All enclosures shall be rated NEMA 4X fiberglass. When applicable all switches shall be mounted on enclosure door.

Pump Design Criteria. Total number of pumps provided by Filter system manufacturer = six (6)

Type of application	Wastewater Coagulant	Wastewater Coagulant	Alkalinity supplement
Skid	Coag-1	Coag-2	Alkalinity
No. Pumps Required	2	2	2
Pump Capacity Range (gph)	0 - 10	0-10	0-9
Pump Equipment Nos.	P-AL-1A P-AL-1B	P-AL-2A P-AL-2B	P-CA-1A P-CA-1B
Pump Discharge Pressure @ Capacity (psi)	30	30	30
Dosage Range (mg/L)	10 - 110	10 - 110	5-40
Chemical Type	Alum	Alum	NaOH
Chemical Specific Gravity	1.34	1.34	1.28
Chemical Percent Active (%)	48%	48%	25%

2.09 SPARE PARTS

- A. Provide spare parts that are identical to and interchangeable with parts installed. Furnish and deliver the following spare parts for each pump:
1. Wet-end diaphragm replacement kit, one per pump.
- B. Spare parts shall be packed in a hinged plastic box with clasp. The box shall be clearly labeled with the contents.

3.00 EXECUTION

3.01 INSTALLATION

- A. Contractor shall install the equipment specified herein in accordance with the Manufacturer's recommendations, and drawings.
- B. The skids shall include nameplates and tags for the pumps as specified in Section 40 05 53 - Identification for Process Piping and Equipment.
- C. Manufacturer's representative provide services during installation, inspect the installation, and provide a Certification of Installation as specified in Specification Section 01 75 00, Testing, Start-Up, and Training.

3.02 TESTING

- A. On-site testing shall comply with the requirements of Section, Equipment Testing, Start-Up, and Training. Pumps shall be tested on specified fluid chemical solution.
- B. Manufacturer's qualified service representative shall provide a minimum of eight (8) hours of on-site testing of the equipment specified herein.
- C. Manufacturer's qualified service representative shall certify the installation and on-site testing in accordance with Section, Testing, Start-Up, and Training.

3.03 TRAINING

- A. Manufacturer's qualified service representative shall provide a minimum of four (4) hours of training of the Owner's staff for operation and maintenance of the pumps.
- B. Training shall meet the requirements of Section 01 75 00, Testing, Start-Up, and Training.

****END OF SECTION****

1.00 GENERAL

1.01 DESCRIPTION OF WORK

- A. Contractor shall provide and install one (1) heavy duty vertical-shaft flash mixer.
- B. Flash mixer shall be provided by the manufacturer of the Automatic Backwash Discfilter. Work covered by this section consists of furnishing all labor, materials, and equipment required to supply, install, and test the equipment specified in this section. The scope of work shall also include delivery, inspection, certification of installation, functional testing, startup, and job site training.
- C. The flash mixer is to be installed in the rapid mix tank, a cross-linked polyethylene tank provided by others. The mixer will be supported by an external mixer support system as indicated on the drawings.
- D. The supplier of the flash mixer shall also supply specific recommendations for anti-swirl baffles for installation in the rapid mix tank. The tank supplier shall supply the baffles, installed at the tank fabrication or manufacturing facility.

1.02 RELATED WORK

- A. Section 01 33 00 – Submittals Procedure
- B. Section 01 60 00 – Product Requirements
- C. Section 01 75 00 – Testing, Start-Up, and Training
- D. Section 09 96 00 - High Performance Coatings
- E. Division 26 - Electrical
- F. Section 40 05 53 - Identification for Process Piping and Equipment
- G. Section 40 05 90 – Common Work Requirements for Process Equipment
- H. Section 40 05 93 - Common Motor Requirements for Process Equipment
- I. Section 46 61 33 – Automatic Backwash Discfilter

1.03 REFERENCE STANDARDS

- A. AFBMA - Anti-Friction Bearing Manufacturers Association
- B. AFBMA Standard 9 - Load Ratings and Fatigue Life for Ball Bearings
- C. AFBMA Standard 11 - Load Ratings and Fatigue Life for Roller Bearings

- D. AGMA - American Gear Manufacturers Association
- E. AGMA 390.03 - Gear Handbook Volume 1: Gear Classification, Materials and Measuring Methods for Unassembled Gears.
- F. AGMA 299.01 - Sound Manual.
- G. AGMA 6010.E88 - Spur, Helical, Herringbone and Bevel Enclosed Drives.
- H. AIChE - American Institute of Chemical Engineers
- I. Method for Evaluating Mixing Equipment, Impeller Type; 2nd. Edition.
- J. ANSI - American National Standards Institute
- K. ASTM - American Society for Testing and Materials
- L. ASTM A36 - Standard Specification for Carbon Structural Steel
- M. ASTM A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
- N. ASTM A276 - Standard Specification for Stainless Steel Bars and Shapes
- O. ASTM A314 - Standard Specification for Stainless Steel Billets and Bars for Forging
- P. ASTM A967 - Standard Specification for Chemical Passivation Treatments for Stainless Steel Parts
- Q. NEMA - National Electrical Manufacturers Association
- R. NEMA MG 1 - Motors and Generators
- S. OSHA - Occupational Safety and Health Administration, Code of Federal Regulations (CFR 29)
- T. SAE - Society of Automotive Engineers
- U. SAE J431 - Automotive Gray Iron Castings
- V. SAE 316 (UNS S31600) – 316 Stainless Steel
- W. SAE 316L (UNS S31603) – 316L Stainless Steel
- X. UL - Underwriters Laboratories
- 1.04 SUBMITTALS
- A. Furnish submittals in accordance with Section 01 33 00 - Submittal Procedures.
- B. Submittal shall also include:

1. Drawings showing complete dimensional data of the proposed mixer design including the mixer outline dimensions, mixer drive, output coupling, and impeller assembly data and mounting details.
 2. The weight of the complete mixer assembly and each component; motor, gearbox, shafting and impellers.
 3. Details of the coupling-shaft sleeve arrangement and axial and torque load calculations.
 4. Description of surface preparation of all components and shop priming and finish painting of components requiring coating.
 5. Mixer design calculations and process design calculations.
 6. Design thrust, torque, and bending moment loads.
 7. Warranty as specified herein.
 8. Fabrication drawing for the anti-swirl baffles.
- C. Operation and Maintenance manuals shall be provided in accordance with Section 01 33 00 - Submittal Procedures.

1.05 MANUFACTURER

- A. The Manufacturer shall be of established good reputation regularly engaged in the fabrication of such equipment. Unless otherwise noted, any equipment offered shall be current modifications which have been in successful regular operation under comparable conditions. Equipment shall be a product of a manufacturer with at least 20 years of experience in manufacture of the specific equipment specified herein, and with at least 20 installations similar to this project in the U.S. each with at least 5 years of satisfactory experience.
- B. The mixers shall be as manufactured by STAMO, Philadelphia Mixer, Lightnin, or equal.
- C. Manufacturer of flash mixing equipment shall be the same manufacturer as the manufacturer of the flocculator vertical mixers (section 46 41 34).

1.06 BIDDING

- A. The cost of the mixers shall be included in the lump sum bid price for the Tertiary Filtration Building.

1.07 WARRANTY

- A. Manufacturer shall warrant the equipment specified herein to be free of defects in materials and workmanship for a period of two (2) years from the Date of Substantial Completion and in accordance with the General Conditions.

2.00 PRODUCTS

2.01 SUPPLIER

- A. Manufacturer of the Automatic Backwash Discfilter shall supply the flash mixer equipment.

2.02 GENERAL

- A. The mixers shall be complete assemblies including but not limited to the gear reducers, motors, shafting, impellers, couplings, mounting bases, anchor bolts, and other appurtenant equipment necessary to be complete and operable in accordance with the requirements of the contract documents.

2.03 MATERIALS

- A. All submerged parts including the mixer shaft and impeller shall be constructed of SAE type 316/316L stainless steel.
- B. All fasteners required for assembly of submerged parts shall be SAE type 316/316L stainless steel.
- C. The minimum material thickness for impeller fabrication is 3/8 inch.

2.04 DESIGN CRITERIA

- A. Number of Basins:
- B. Number of basins: 1
- C. Diameter: 5'-1"
- D. Total tank depth: 10'-10"
- E. Side Water Depth, max (not normal operating mode, surcharged from downstream condition): 9'-5"
- F. Side Water Depth, normal operating max.: 7'-1"
- G. Side Water Depth, normal operating min.: 6'-10"
- H. Freeboard @ max. SWD: 1'-5"

2.05 FLASH MIXER EQUIPMENT

- A. Flash mixer assembly shall consist of a heavy-duty speed reducer, premium efficient electric motor, baseplate, agitator shaft, and mixing impellers. Mechanical details of each component shall be as follows:
 - 1. The mixer gear drive must be built in accordance with the current AGMA Standards. The AGMA calculated drive HP rating shall be stamped on the drive nameplate. Drive housings shall be of high quality close grained cast iron, or fabricated steel, stress

relieved and reinforced, and shall be provided with lifting lugs. If required for ease of assembly of the agitator shaft or to facilitate draining of the oil from the gear drive, each unit shall be provided with an integral or separate baseplate and shall have a minimum clearance of 12 inches.

2. Gearing must be vertical parallel shaft, all helical gears or helical spiral bevel to ensure the highest efficiency coupled with the convenience of mounting and maintenance (worm gearing is not acceptable). Helical gears shall be a minimum AGMA Quality 10 per AGMA standard 390.03. Spiral/bevel sets shall be a minimum AGMA Quality 8, matched and lapped. The gears shall be lubricated from a common oil bath or grease lubricated. The full load operating noise levels of the mixer drives shall not exceed 85 dBA at 3 feet from any part of the drive assembly.
3. The mixer gear drive shall be designed with an output shaft system suitable for the loadings imposed by the specific duty. The drive's minimum AGMA service factor shall be 1.5 and based upon motor nameplate horsepower. Service factors based on uniform load and motor bhp will not be accepted. Agitator gear drive coupled to impeller shaft must be designed, manufactured, and tested by the mixer supplier.
4. All drive bearings shall be of the antifriction type, ball or roller bearings. All bearings within the drive, including output shaft bearings, shall have minimum AFBMA B-10 lives of 50,000 hours when operating at full motor nameplate horsepower at design speed.
5. Each drive must have an effective lubrication of rotating elements without leakage down the output shaft. Output shaft bearings may be grease lubricated.
6. The electric motors shall have a 1.15 service factor and TEFC/TENV enclosure with class F insulation and class B temperature rise above 40 deg C ambient. The motors shall be squirrel cage induction motors for operation on 3 phase, 60 hertz, 230/460 volt current with synchronous speed of 1800 RPM or less. Motors shall be premium efficiency type and rated for severe duty. Efficiency shall be determined in accordance with IEEE 112, Test Method B. The motor shall be connected to the input shaft with a rigid or flexible coupling and shall be pilot mounted with a NEMA C face flange. Integral mounted motors shall be accepted. IEC or other non-NEMA motor flanges will not be accepted. All motors shall be designed constructed and tested in accordance with applicable IEEE, NEA, and ANSI, standards.
7. The lower mixer shaft shall be connected to the upper, or drive output shaft, by means of a rigid flanged or integral coupling.
8. The agitator shaft shall be of 304 stainless steel construction or other approved material as recommended by the mixer manufacturer. The shaft shall be designed such that the combined (Mohrs circle) maximum shear stress shall not exceed 9,000 psi under maximum operating loads for stainless steel. It shall be of overhung design for use in complete coverage (liquid levels at least one impeller diameter above the impeller height). The use of underwater steady bearings is not permitted. The coagulation and flocculation tank agitators shafts shall have extended keyways to allow the impeller to be placed at the mixer manufacturer's recommended distance off of the tank bottom.

9. Mixing impellers for coagulation and flocculation application shall be axial flow, hydrofoil type and shall be pitched or vertical blade for rapid mix applications or as recommended by the mixer manufacturer. Impellers shall be constructed of 304 stainless steel or other approved material as recommended by the mixer manufacturer. Impellers shall be bolted construction and shall be connected to the agitator shaft with a hook key for maximum security if round shaft or as required. The maximum stress in any impeller component shall not exceed 11,000 psi under maximum operating loads.
10. Upon installation each unit shall be run to demonstrate its ability to operate without overloading, jamming, or excessive vibration during normal operation.
11. All non-wetted parts will be shipped with manufacturer's standard factory paint, suitable for use as a finish coat. All touch-up and additional coats are to be applied in the field by the contractor. Wetted parts, of 304 or 316 stainless steel, will not be painted.

2.06 ANCHOR BOLTS

- A. The installing contractor will furnish all required 316 stainless steel anchors and hardware.

2.07 SPARE PARTS AND SPECIAL TOOLS

- A. Manufacturer shall furnish one (1) set of standard spare parts.
- B. Furnish all spare parts for one year's normal operation and maintenance of the equipment, including lubricants.
- C. As minimum, one spare set of seals and gaskets shall be included for each size of drive.
- D. Manufacturer shall furnish one (1) set of all special tools required for the proper servicing of all equipment supplied under these specifications.
- E. Spare parts shall be packed in a hinged plastic box with clasp. The box shall be clearly labeled with the contents.

2.08 COATINGS

- A. Non-stainless steel surfaces shall be shop-primed and painted in accordance with Section 09 96 00, High Performance Coatings.
- B. Drive to be shipped with oil filled to the proper level for operation.
- C. Exterior portions of the steel shaft and the motor coupling shall be protected with a waxy film, moisture-excluding coating.

2.09 ANTI-SWIRL BAFFLE

- A. Contractor shall furnish and install two (2) vertical anti-swirl baffles, 8" wide x 6'-0" tall x 1/4" thick, constructed of 316 SS plate and provided with 316 SS mounting brackets, 316 SS epoxy anchor bolts and fasteners. The baffles shall be mounted at 180 degree positions in the tank.

- B. Mixer Manufacturer shall provide a recommended detail to the Contractor from which the Contractor can develop fabrication drawings and submit the fabrication drawings to the Engineer for review and approval.

2.10 CONTROLS

- A. Flash mixer shall be controlled from the Coagulation/Flocculation System control panel, which shall be supplied by the Automatic Backwash Discfilter supplier. The Coagulation/Flocculation System Control Panel is described in 46 61 33 2.10. tall

3.00 EXECUTION

3.01 STORAGE

- A. All gears and bearings shall be protected from rusting during storage by the application of a shop applied protective coating.

3.02 INSTALLATION

- A. Contractor shall install the equipment specified herein in accordance with the Manufacturer's recommendations, drawings, and Section 01 60 00, Product Requirements.
- B. Contractor shall provide all required structural supports for mixers required by the Manufacturer's design and structural contract drawings (refer to drawing FS8).
- C. The motor shall be provided with nameplates and tags as specified in Section 40 05 53, Identification for Piping and Equipment.
- D. Manufacturer's representative provide services during installation, inspect the installation, and provide a Certification of Installation as specified in Specification Section 01 75 00, Testing, Start-Up, and Training.

3.03 COATING

- A. The equipment coatings shall be touched up in the field by the Contractor in accordance with Section 09 96 00, High Performance Coatings.

3.04 TESTING

- A. Each mixer drive shall be completely shop assembled and factory tested to assure proper fit-up, and acceptable limits of vibration, shaft run out and motor power draw, prior to shipment.
- B. On-site testing shall comply with the requirements of Section 01 75 00, Equipment Testing, Start-Up, and Training.
- C. Manufacturer's representative shall verify that the mixers do not exceed acceptable field vibration limits throughout the mixer operating range.
- D. Manufacturer's qualified service representative shall certify the installation and on-site testing in accordance with Section 01 75 00, Testing, Start-Up, and Training.

- E. Manufacturer's qualified service representative shall provide a minimum of eight (8) hours of on-site testing of the equipment specified herein.

3.05 TRAINING

- A. Manufacturer's qualified service representative shall provide a minimum of eight (8) hours of training of the Owner's staff for operation and maintenance of the equipment specified herein.
- B. Training shall meet the requirements of Section 01 75 00, Testing, Start-Up, and Training.

END OF SECTION

1.00 GENERAL

1.01 DESCRIPTION OF WORK

- A. Contractor shall provide and install two (2) heavy duty vertical-shaft flocculators for the flocculator tanks.
- B. Flocculators shall be provided by the manufacturer of the Automatic Backwash Discfilter. Work covered by this section consists of furnishing all labor, materials, and equipment required to supply, install, and test the equipment specified in this section. The scope of work shall also include delivery, inspection, certification of installation, functional testing, startup, and job site training.
- C. The flocculators are to be installed in the flocculation tanks, two (2) FRP tanks provided by others. The flocculators will be supported by an external mixer support systems as indicated on the drawings.
- D. The supplier of the flocculators shall provide specific requirements for anti-swirl baffles for the tanks, including dimensional requirements for the supply and installation by the tank fabricators. Tank fabricator shall be responsible for determining mounting requirements of baffles and for installation at the tank factory. Recommendations and supply coordination shall be the responsibility of the contractor.

1.02 RELATED WORK

Section 01 33 00 – Submittals Procedure

Section 01 60 00 – Product Requirements

Section 01 75 00 – Testing, Start-Up, and Training

Section 09 96 00 - High Performance Coatings

Division 26 - Electrical

Section 40 05 53 - Identification for Process Piping and Equipment

Section 40 05 90 – Common Work Requirements for Process Equipment

Section 40 05 93 - Common Motor Requirements for Process Equipment

Section 46 61 33 – Automatic Backwash Discfilter

1.03 REFERENCE STANDARDS

AFBMA - Anti-Friction Bearing Manufacturers Association

AFBMA Standard 9 - Load Ratings and Fatigue Life for Ball Bearings

AFBMA Standard 11 - Load Ratings and Fatigue Life for Roller Bearings

AGMA - American Gear Manufacturers Association

AGMA 390.03 - Gear Handbook Volume 1: Gear Classification, Materials and Measuring Methods for Unassembled Gears.

AGMA 299.01 - Sound Manual.

AGMA 6010.E88 - Spur, Helical, Herringbone and Bevel Enclosed Drives.

AIChE - American Institute of Chemical Engineers

Method for Evaluating Mixing Equipment, Impeller Type; 2nd. Edition.

ANSI - American National Standards Institute

ASTM - American Society for Testing and Materials

ASTM A36 - Standard Specification for Carbon Structural Steel

ASTM A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

ASTM A276 - Standard Specification for Stainless Steel Bars and Shapes

ASTM A314 - Standard Specification for Stainless Steel Billets and Bars for Forging

ASTM A967 - Standard Specification for Chemical Passivation Treatments for Stainless Steel Parts

NEMA - National Electrical Manufacturers Association

NEMA MG 1 - Motors and Generators

OSHA - Occupational Safety and Health Administration, Code of Federal Regulations (CFR 29)

SAE - Society of Automotive Engineers

SAE J431 - Automotive Gray Iron Castings

SAE 316 (UNS S31600) – 316 Stainless Steel

SAE 316L (UNS S31603) – 316L Stainless Steel

UL - Underwriters Laboratories

1.04 SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 - Submittal Procedures.

- B. Submittal shall also include:
1. Drawings showing complete dimensional data of the proposed mixer design including the mixer outline dimensions, mixer drive, output coupling, and impeller assembly data and mounting details.
 2. The weight of the complete mixer assembly and each component; motor, gearbox, shafting and impellers.
 3. Details of the coupling-shaft sleeve arrangement and axial and torque load calculations.
 4. Description of surface preparation of all components and shop priming and finish painting of components requiring coating.
 5. Mixer design calculations and process design calculations.
 6. Design thrust, torque, and bending moment loads.
 7. Warranty as specified herein.
 8. Fabrication drawing for the anti-swirl baffles.
- C. Operation and Maintenance manuals shall be provided in accordance with Section 01 33 00 - Submittal Procedures.

1.05 MANUFACTURER

- A. The Manufacturer shall be of established good reputation regularly engaged in the fabrication of such equipment. Unless otherwise noted, any equipment offered shall be current modifications which have been in successful regular operation under comparable conditions. Equipment shall be a product of a manufacturer with at least 20 years of experience in manufacture of the specific equipment specified herein, and with at least 20 installations similar to this project in the U.S. each with at least 5 years of satisfactory experience.
- B. The mixers shall be as manufactured by STAMO, Philadelphia Mixer, Lightnin, or equal.
- C. Manufacturer of flocculators shall be the same manufacturer as the manufacturer of the flash mixer equipment (section 46 41 11).

1.06 BIDDING

- A. The cost of the flocculators shall be included in the lump sum bid price for the Tertiary Filtration Building.

1.07 WARRANTY

- A. Manufacturer shall warrant the equipment specified herein to be free of defects in materials and workmanship for a period of two (2) years from the Date of Substantial Completion and in accordance with the General Conditions.

2.00 PRODUCTS

2.01 SUPPLIER

- A. Manufacturer of the Automatic Backwash Discfilter shall supply the flocculator equipment.

2.02 GENERAL

- A. The flocculator mixers shall be complete assemblies including but not limited to the gear reducers, motors, shafting, impellers, couplings, mounting bases, anchor bolts, and other appurtenant equipment necessary to be complete and operable in accordance with the requirements of the contract documents.

2.03 MATERIALS

- A. All submerged parts including the mixer shaft and impeller shall be constructed of SAE type 316/316L stainless steel.
- B. All fasteners required for assembly of submerged parts shall be SAE type 316/316L stainless steel.
- C. The minimum material thickness for impeller fabrication is 3/8 inch.

2.04 DESIGN CRITERIA

1. Number of Basins:
2. Number of basins: 2
3. Diameter: 8'-0"
4. Total tank depth: 11'-5"
5. Side Water Depth, max (not normal operating mode, surcharged from downstream condition): 10'-5.5"
6. Side Water Depth, normal operating max.: 8'-9.25"
7. Side Water Depth, normal operating min.: 8'-5.5"
8. Freeboard @ max. SWD: 1'-0"

2.05 Flocculator Mixer Equipment

- B. Flocculator mixer assemblies shall consist of a heavy-duty speed reducer, premium efficient electric motor, baseplate, agitator shaft, and mixing impellers. Mechanical details of each component shall be as follows:

1. The mixer gear drive must be built in accordance with the current AGMA Standards. The AGMA calculated drive HP rating shall be stamped on the drive nameplate. Drive housings shall be of high quality close grained cast iron, or fabricated steel, stress relieved and reinforced, and shall be provided with lifting lugs. If required for ease of assembly of the agitator shaft or to facilitate draining of the oil from the gear drive, each unit shall be provided with an integral or separate baseplate and shall have a minimum clearance of 12 inches.
2. Gearing must be vertical parallel shaft, all helical gears or helical spiral bevel to ensure the highest efficiency coupled with the convenience of mounting and maintenance (worm gearing is not acceptable). Helical gears shall be a minimum AGMA Quality 10 per AGMA standard 390.03. Spiral/bevel sets shall be a minimum AGMA Quality 8, matched and lapped. The gears shall be lubricated from a common oil bath or grease lubricated. The full load operating noise levels of the mixer drives shall not exceed 85 dBA at 3 feet from any part of the drive assembly.
3. The mixer gear drive shall be designed with an output shaft system suitable for the loadings imposed by the specific duty. The drive's minimum AGMA service factor shall be 1.5 and based upon motor nameplate horsepower. Service factors based on uniform load and motor bhp will not be accepted. Agitator gear drive coupled to impeller shaft must be designed, manufactured, and tested by the mixer supplier.
4. All drive bearings shall be of the antifriction type, ball or roller bearings. All bearings within the drive, including output shaft bearings, shall have minimum AFBMA B-10 lives of 50,000 hours when operating at full motor nameplate horsepower at design speed.
5. Each drive must have an effective lubrication of rotating elements without leakage down the output shaft. Output shaft bearings may be grease lubricated.
6. The electric motors shall have a 1.15 service factor and TEFC/TENV enclosure with class F insulation and class B temperature rise above 40 deg C ambient. The motors shall be squirrel cage induction motors for operation on 3 phase, 60 hertz, 230/460 volt current with synchronous speed of 1800 RPM or less. Motors shall be premium efficiency type and rated for severe duty and inverter duty. Efficiency shall be determined in accordance with IEEE 112, Test Method B. Flocculation mixer motors are to be used with AC inverters that shall meet NEMA MG1, part 31 for variable torque, 10:1 turndown operation. The motor shall be connected to the input shaft with a rigid or flexible coupling and shall be pilot mounted with a NEMA C face flange. Integral mounted motors shall be accepted. IEC or other non-NEMA motor flanges will not be accepted. All motors shall be designed constructed and tested in accordance with applicable IEEE, NEA, and ANSI, standards.
7. The lower mixer shaft shall be connected to the upper, or drive output shaft, by means of a rigid flanged or integral coupling.
8. The agitator shaft shall be of 304 stainless steel construction or other approved material as recommended by the mixer manufacturer. The shaft shall be designed such that the combined (Mohrs circle) maximum shear stress shall not exceed 9,000 psi under maximum operating loads for stainless steel. It shall be of overhung design for use in

complete coverage (liquid levels at least one impeller diameter above the impeller height). The use of underwater steady bearings is not permitted. The coagulation and flocculation tank agitators shafts shall have extended keyways to allow the impeller to be placed at the mixer manufacturer's recommended distance off of the tank bottom.

9. Mixing impellers for coagulation and flocculation application shall be axial flow, hydrofoil type and shall be pitched or vertical blade for rapid mix applications or as recommended by the mixer manufacturer. Impellers shall be constructed of 304 stainless steel or other approved material as recommended by the mixer manufacturer. Impellers shall be bolted construction and shall be connected to the agitator shaft with a hook key for maximum security if round shaft or as required. The maximum stress in any impeller component shall not exceed 11,000 psi under maximum operating loads.
10. Upon installation each unit shall be run to demonstrate its ability to operate without overloading, jamming, or excessive vibration during normal operation.
11. All non-wetted parts will be shipped with manufacturer's standard factory paint, suitable for use as a finish coat. All touch-up and additional coats are to be applied in the field by the contractor. Wetted parts, of 304 or 316 stainless steel, will not be painted.

2.05 ANCHOR BOLTS

The installing contractor will furnish all required 316 stainless steel anchors and hardware.

2.06 SPARE PARTS AND SPECIAL TOOLS

- A. Manufacturer shall furnish one (1) set of standard spare parts.
- B. Furnish all spare parts for one year's normal operation and maintenance of the equipment, including lubricants.
- C. As minimum, one spare set of seals and gaskets shall be included for each size of drive.
- D. Manufacturer shall furnish one (1) set of all special tools required for the proper servicing of all equipment supplied under these specifications.
- E. Spare parts shall be packed in a hinged plastic box with clasp. The box shall be clearly labeled with the contents.

2.07 COATINGS

- A. Non-stainless steel surfaces shall be shop-primed and painted in accordance with Section 09 96 00, High Performance Coatings.
- B. Drive to be shipped with oil filled to the proper level for operation.
- C. Exterior portions of the steel shaft and the motor coupling shall be protected with a waxy film, moisture-excluding coating.

2.08 ANTI-SWIRL BAFFLE

- A. Contractor shall furnish and install two (2) vertical anti-swirl baffles, 8" wide x 6'-0" tall x 1/4" thick, constructed of 316 SS plate and provided with 316 SS mounting brackets, 316 SS epoxy anchor bolts and fasteners. The baffles shall be mounted at 180 degree positions in the tank.
- B. Mixer Manufacturer shall provide a recommended detail to the Contractor from which the Contractor can develop fabrication drawings and submit the fabrication drawings to the Engineer for review and approval.

2.09 CONTROLS

- A. Flocculator mixers shall be controlled from the Coagulation/Flocculation System control panel, which shall be supplied by the Automatic Backwash Discfilter supplier. The Coagulation/Flocculation System Control Panel is described in 46 61 33 2.10.

3.00 EXECUTION

3.01 STORAGE

- A. All gears and bearings shall be protected from rusting during storage by the application of a shop applied protective coating.

3.02 INSTALLATION

- A. Contractor shall install the equipment specified herein in accordance with the Manufacturer's recommendations, drawings, and Section 01 60 00, Product Requirements.
- B. Contractor shall provide all required structural supports for mixers required by the Manufacturer's design and structural contract drawings (refer to drawing FS8).
- C. The motor shall be provided with nameplates and tags as specified in Section 40 05 53, Identification for Piping and Equipment.
- D. Manufacturer's representative provide services during installation, inspect the installation, and provide a Certification of Installation as specified in Specification Section 01 75 00, Testing, Start-Up, and Training.

3.03 COATING

- A. The equipment coatings shall be touched up in the field by the Contractor in accordance with Section 09 96 00, High Performance Coatings.

3.04 TESTING

- A. Each mixer drive shall be completely shop assembled and factory tested to assure proper fit-up, and acceptable limits of vibration, shaft run out and motor power draw, prior to shipment.

- B. On-site testing shall comply with the requirements of Section 01 75 00, Equipment Testing, Start-Up, and Training.
- C. Manufacturer's representative shall verify that the mixers do not exceed acceptable field vibration limits throughout the mixer operating range.
- D. Manufacturer's qualified service representative shall certify the installation and on-site testing in accordance with Section 01 75 00, Testing, Start-Up, and Training.
- E. Manufacturer's qualified service representative shall provide a minimum of eight (8) hours of on-site testing of the equipment specified herein.

3.05 TRAINING

- A. Manufacturer's qualified service representative shall provide a minimum of eight (8) hours of training of the Owner's staff for operation and maintenance of the equipment specified herein.
- B. Training shall meet the requirements of Section 01 75 00, Testing, Start-Up, and Training.

END OF SECTION

1. Self-supporting fiberglass reinforced plastic submerged effluent launder (SEL) including anchors and fasteners.
 2. SEL surface sweeping mechanism with fastening hardware.
 3. Flow control box including flow control gate with anchors, actuator, and retrofitting existing concrete box.
 4. Two (2) radar level sensors with mounting hardware.
 5. Pre-programmed local control panel with PLC.
 6. Modifications as needed to the existing clarifiers to accommodate new system and to provide complete operational clarifiers.
 7. Any other appurtenances, accessory, item, product, material, etc. required for a complete and operational system.
3. The SEL shall eliminate the need for traditional surface level “U” shaped launders, launder covers, algae cleaning systems, scum baffles, density current baffles and effluent weirs. The SEL shall be designed to provide an even effluent flow distribution at the tank perimeter and minimize algae growth.
 4. All anchor bolts and assembly fasteners shall be 304 stainless steel.

B. Products:

1. Each submerged effluent launder shall be a tank perimeter mounted submerged effluent launder with flow entering horizontally oriented equally spaced ports of varying size on the effluent launder upper panel. The submerged effluent launder discharge flow rate shall be automatically controlled using a slide gate, radar liquid level sensors and PLC controls. The submerged effluent launder shall be designed to remove effluent liquid uniformly at the tank perimeter.

C. Submerged Effluent Launder:

1. The SEL shall be self-supporting and fabricated of fiberglass reinforced plastic. It shall be comprised of an upper and lower launder plate.
2. The upper launder plate includes three sections that serve five functions. The upper section is a vertical plate that functions as a scum baffle and as a connection point to the clarifier tank wall. The middle section, integral to the upper and lower section and angled downwardly and obliquely, functions as the upper boundary of the submerged launder. In addition, orifices are located near the bottom of the middle section to collect clarifier effluent. Orifices are significantly submerged to minimize sunlight to minimize algae growth serving the function of a launder cover. The lower section is integral to the upper and middle section and angled downwardly and obliquely, extending below the lower launder plate serving as a density current baffle.
3. The lower launder section serves as the bottom boundary of the submerged launder. It is anchored to the clarifier tank wall and is fastened to the upper launder section above the density current baffle section and below the orifices.
4. The SEL™ shall not exceed the following design parameter:

- a. Maximum headloss of 12 inches through the SEL.
 - b. Maximum internal launder flow velocity 4 fps.
 - c. Maximum orifice velocity 6 fps.
5. The following SEL parameters shall be calculated using the OVIVO USA, LLC proprietary sizing program, or approved equal:
- a. Orifice diameter, depth and spacing.
 - b. Total number of orifices.
 - c. Upper launder plate angle of projection from horizontal plane.
 - d. Length of density current plate.
 - e. Headloss
 - f. Maximum launder internal flow velocity.
 - g. Maximum orifice velocity.
 - h. Flowrate of each orifice to ensure flow rate is evenly distributed to each orifice within a standard deviation of $\pm 6\%$ at design flow conditions.

D. Flow Control Box:

1. Contractor shall modify existing influent/effluent box for use with the submerged effluent launder system flow control box. Modifications shall be designed by the manufacturer for this specific installation using the pre-construction as-built information (see requirements herein). Shall include: design of the flow control box and appurtenances including overflow weir sizing (for max clarifier capacity) and construction of the flow control box including concrete modifications and furnishing/installing flow control slide gate and actuator, level liquid sensors mounted in accordance with manufacturer's requirements, over flow weir, and any other item needed for flow control for the submerged effluent launder system in accordance with the manufacturers recommendations.

D. Flow Control Slide Gate:

1. Shall be stainless steel slide gate manufactured by Orbinox, model MU, 4-sided sealing slide gate.

E. Slide Gate Actuator:

1. The slide gate actuator shall be manufactured by Rotork, model IQM (Modulating). The actuator shall have the following characteristics: 4-20mA input/output, 3 phase, 60 Hz power supply, IP 68 watertight enclosure, local integral controls, LCD display.
2. The actuator shall be lubricated in strict accordance with the equipment's operation and maintenance instructions. The required lubricants shall be provided by the contractor.

G. Liquid Level Sensor:

1. The liquid level sensors shall be manufactured by Endress+Hauser, model number FMR20-1RU0/0.

G. Control Panel:

1. Pre-programmed local control panel with PLC in NEMA 4X stainless steel enclosure with operator controls and HMI operator interface on an internal swingout panel, HMI trend display for water level and actuator position, hand-off-auto selector switch, open-close switch, an un-interruptible power supply, relays for alarms, and surge suppression.

3.00 EXECUTION

3.01 PREPARATION

- A. Clarifier basin shall be prepared for installation of the equipment in accordance with manufacturers recommendations and as needed for installation and for a fully operation system.
- B. Contractor shall verify all dimension in the field to ensure compliance of equipment dimensions with the drawings. See as-built requirements in section 1.00 of this specification

3.02 FACTORY TEST:

- A. Manufacturer shall submit protocol for factory test for owner review.
- B. Manufacturer to submit factory test results report for review by Owner prior to shipment of the assembled unit to the jobsite.

3.03 DELIVERY OF EQUIPMENT:

- A. Contractor shall coordinate work herein with construction sequencing and phasing requirements included in the Contract Documents.
- B. Equipment supplied under this section shall not to be delivered to the site until construction has progressed to the point where installation may properly commence.
- C. All equipment shall be protected and shall be in accordance with the Manufacturer's recommendations.
- D. Contractor shall replace any equipment damaged after receipt of equipment at no cost to the Owner.

3.04 INSTALLATION:

- A. Installation shall be in strict accordance with the Manufacturer's recommendations and instructions and shall be in accordance with the specifications herein and the Drawings. Installation shall include all equipment, labor, materials, connections, or any other item needed for complete and operational clarifier equipment.
- B. All equipment, components, piping and appurtenances shall be installed true to alignment and rigidly supported. Any damage caused by the negligence of the Contractor to the above items shall be repaired or replaced by the Contractor to its original condition.
- C. Manufacturer's representative to inspect the installation prior to startup in order to verify that the equipment has been properly installed.

- D. Manufacturer's representative shall calibrate the equipment with the Owner's operator present after installation prior to startup.
- E. All products, accessories, and appurtenances shall be installed in accordance with manufacturer's instructions and approved submittals.
- F. The Contractor shall provide all hardware and accessories required for installation.
- G. Anchor bolts and all needed connectors are to be sized by Manufacturer and provided by Contractor.

3.05 MANUFACTURER'S ASSISTANCE:

- A. Manufacturer shall provide installation instruction manuals for Contractor's assistance at least 30 days prior to shipment of factory assembled treatment units
- B. Manufacturer shall provide assistance regarding handling, assembly and installation requirements for complete installation by the Contractor.
- C. Manufacturer shall provide assistance as needed for construction of the clarifier equipment.
- D. Contractor shall verify all equipment is installed in accordance with the manufacturer's recommendations and literature and the Drawings.

3.06 FIELD QUALITY CONTROL

A. Service:

- 1. Qualified service personnel must be available on a 24 hours a day basis
- 2. The personnel must be completely familiar with the items supplied so as to return inoperative equipment to service in the shortest possible time
- 3. The pre-qualification information is to include the following:
 - a. Name, educational background and years of service experience for all service personnel

B. Tests:

- 1. Field testing and checking of installation to be approved by Manufacturer's field representative
- 2. Test under full load conditions
- 3. Verify that all control system functions, including alarms, perform as specified
- 4. Any spare parts furnished as specified but used during startup must be replaced prior to final acceptance
- 5. Manufacturer's field representative to perform field test
- 7. If equipment fails to meet performance specifications, the manufacturer, at no cost to the owner, shall modify, replace, and otherwise do whatever is necessary to provide equipment that will pass the equipment testing specification.

C. Manufacturers Field Services:

1. The equipment manufacturer shall provide a service representative properly trained in inspection and operation of the mechanism to approve the installation, certify that the torque settings of the drive overload protection device are correct, perform the torque test and instruct the owner's personnel on maintenance and operation. This service shall be as required for confirmation of proper operation of the equipment, and owner training and shall be in the form of a minimum four (4) trips to the site and five (5), eight (8) hour days of service.
2. Qualified factory-trained representative to provide startup and operator training services. Representative to be available within two (2) weeks of request for services. Representative to provide following services:
 - a. Equipment installation review and certification of proper installation: Provide one (1) trip; minimum of eight (8) hours onsite for initial visit to checkout installation and verify that centrifuge system is ready to operate
 - b. Startup and operator training: Provide one (1) trip of minimum two (2), 8-hour days to provide classroom training of operating personnel in the operation of centrifuge system and to provide "hands-on" training for operation of equipment
 - c. Six (6) month performance review and post startup training: One (1) trip of 8-hours minimum to make operating adjustments and provide additional instruction to Owners personnel within 6 months after final acceptance of equipment

3.07 LIFTING AND MOVING EQUIPMENT

- A. Lifting points shall be identified on all equipment. A crane of sufficient capacity must be on site for unloading the equipment from the truck and placing in the channel for installation.

END OF SECTION

1.00 GENERAL

1.01 DESCRIPTION

A. The work in this section consists of supplying and installing the following Biological Phosphorus Removal Equipment, system start-up and training, and operational assistance to optimize biological phosphorus removal in this specific application.

1. One (1) 2.01 horsepower submersible, mechanical mixers for installation in the Anaerobic zone(s). Each mixer shall consist of a drive motor, gear reducer, impeller, guide rail and manual lifting hoist assembly.
2. One (1) Oculus™ Control System consisting of monitoring for each D.O.& ORP loop, using Owner's VFD(s) and MLSS pump(s) and control logic for the Carrousel basin process.

B. All the equipment specified under this Section shall be furnished by a single Manufacturer (the Anaerobic Mixer and Bio-P Control System Manufacturer) fully experienced, reputable, and qualified in the manufacture of the equipment specified. Related Sections:

1. Section 01 33 00 Submittals, Training and Facility Start-Up
2. Section 43 25 00 Mixed Liquor Recycle Pumps

1.02 REFERENCES

- A. American Gear Manufacturers Association (AGMA)
- B. National Electrical Manufacturers Association (NEMA)
- C. American Federation of Bearing Manufacturers Association (AFBMA)
- D. American Society for Testing and Materials (ASTM)
- E. American Welding Society (AWS)
- F. Steel Structures Painting Council, American National Standards Institute (SSPC)

1.03 SUBMITTALS

A. Shop drawing submittals shall include at least the following:

1. Certified shop and erection drawings showing all important details of construction dimensions, mounting bolt locations, and field connections.
2. Descriptive literature, bulletins, and catalogs of the equipment, including details of lubrication points.
3. Installation, operation, and start-up procedures including lubrication requirements.
4. Complete motor data.

5. Total weight of the equipment including the weight of the single largest item.
6. A complete bill of materials for all equipment with the O&M manual. No samples will be required.
7. A list of spare parts that are supplied with the project.

1.04 OPERATION AND MAINTENANCE MANUALS

- A. Submit operations and maintenance manuals for the equipment in compliance with the Contract documents, 30 days prior to shipment. Manuals shall include:
1. Name, address, and telephone number of the nearest competent service representative who can furnish parts and technical service.
 2. Descriptive literature, including illustrations, covering the operational features of the equipment, specific for the particular installation, with all inapplicable information omitted or marked out.
 3. Operating, maintenance and troubleshooting information.
 4. Complete maintenance parts list.
 5. Complete connection, interconnecting and assembly diagrams.
 6. Approved Shop Drawings.

1.05 STORAGE AND HANDLING OF EQUIPMENT

- A. The Contractor shall store and temporarily support equipment prior to installation in strict accordance with the Manufacturer's recommendations and instructions. Protect all exposed surfaces. Keep records of the storage parameters and the dates that storage procedures were performed. The Contractor shall be responsible for work, equipment, and materials until inspected, tested and finally accepted.
- B. Store gear reducers, motors, VFD's and control system components in buildings or trailers which have a concrete or wooden floor, a roof and fully closed walls on all sides. Protect the equipment from being contaminated by dust, dirt, vibration and moisture.
- C. Temporarily connect equipment with built in space heaters to a power source and keep heaters in operation. Rotate all shafts that have bearings on at least a monthly basis.

2.00 PRODUCTS

The products and service intended for implementation at the Leavenworth Wastewater Treatment Plant is based on Carrousel[®] BNR System equipment and service provided by Ovivo (Salt Lake City, UT).

2.01 ACCEPTABLE SUPPLIER

- A. Acceptable supplier is Ovivo (Salt Lake City, UT) or preapproved alternate. Preapproval of the alternate shall follow the process outlined in Article 11 of the Instructions to Bidders.

2.02 MIXER DESIGN AND PERFORMANCE

- A. The submersible mixers for the System shall be and furnished by the aerator manufacturer, and, where possible, shall be of the identical model. Each mixer shall include a motor, gear reduction section, bearings, mechanical seals, stainless steel shafts, A48 class 35 or 40 Cast Iron housing, and machined fits for circular cross section O-rings, non-clogging propeller, designed for mixing raw or processed sewage. Each mixer shall be mounted in the basin and each unit shall have a hoist and rail retrieval system that does not require anyone entering the basin to install or remove the mixer.
- B. The mixer design is based on the performance requirements for the biological nutrient removal system; consideration of the future long-term operational and maintenance costs to the Owner; minimum pumping rate required per basin; optimization of mixing efficiency (HP/MG) and long-term power use (e.g., geared units required for the anoxic basins); efficiency and hydraulic profile of the polyurethane blade design; and specific features (e.g., silicon carbide mechanical seals, pre-chamber) to protect against moisture intrusion into the unit. No exceptions will be made to these performance requirements as specified in this section.
- C. Note existing mixers in existing basins will be utilized in the biological phosphorus removal upgrades. The existing mixing equipment shall be controlled manually (on-off and manual speed settings) using existing control systems, not requiring integration with the new Bio-P control system.
- D. Performance (new mixer):
 - 1. Anaerobic Basin mixer key details.
 - a. Number of mixers required - One (1)
 - b. 304 rpm (Maximum) propeller speed.
 - c. Maximum Power draw - 2.01 HP (motor is 2.7 HP)
 - d. 7 MGD / Cell mixer pumping rate (minimum)
 - e. 112 lbs of thrust.

2.03 MIXER MOTORS

- A. Each mixer shall be furnished with a squirrel cage, induction motor enclosed in a watertight housing suitable for use and compatible with variable frequency drive systems without special order requirements such as “inverter duty”. The motors shall be furnished with moisture resistant Class F insulation treated to be moisture resistant, NEMA B design designed for continuous duty and shall be non overloading throughout the entire mixer range of operation without utilizing the motor service factor. Motors shall be capable of sustaining 15 starts per hour (unlimited starts with VFD) at a minimum ambient temperature of 40°C. Motors shall be capable of uninterrupted operation with a voltage drop of 10%.

- B. The motor rotor and stator, as well as all bearings shall be located in an air filled chamber that is isolated from the seal chamber. Motor cooling shall be accomplished by submergence in the mixed liquid. Thermal switches shall be furnished to monitor stator temperatures. The stator shall be equipped with two (2) thermal switches, embedded in the end coils of the stator winding. Thermal switches shall automatically de energize the motor when its temperature exceeds a preset limit. The mixer manufacturer's nameplates shall be engraved or stamped on stainless steel and fastened to the motor casing with stainless steel screws or drive pins.
- C. Power and control cables shall be furnished in lengths to run continuously from the mixer to the mixer control panel or disconnect as shown on the Contract Drawings and as specified herein. Cables shall terminate with conductor sleeves. Cables shall be of the "NSSHOU" type and shall conform to industry standards for loads, resistance under submersion against sewage, and be of stranded construction. The power cables entering the motor housing shall prevent the moisture from gaining access to the motor even in the event of complete power or control cable break while under water. The cables shall enter the mixer through a heavy-duty entry assembly that shall be provided with an internal grommet assembly to protect against tension once secured and must have a strain relief assembly as part of standard construction. The cables for each mixer shall be bundled in 10 ft segments for overall neatness and ease of mixer removal.

2.04 MIXER GEAR REDUCER

- A. The motor shall drive the anaerobic submersible mixer propeller through a planetary gear reduction drive system. The motor shaft shall be fitted with a gear that uses high efficiency teeth to engage the gear section. The gear system shall be custom matched to allow for propeller speed changes by ordering and installing new gearing. The gear section shall be designed to withstand 100 % lock stress from the propeller without gear or bearing damage. Each gear shall be supplied with precision bearings, which are lubricated by the gear lubricant in the gear chamber. The gear section shall be fitted to the output propeller shafting by the use of a straight spline connection. The gear section design shall be such that with regular oil changes, no further maintenance should be required during the life of the submersible mixer in the installation. Gear oil changes shall be easily made using external stainless steel pipe plugs that are sealed via nylon washers. Standard 80 to 90-weight gear oil either normal or synthetic shall lubricate the gear section.
- B. Each anaerobic submersible mixer shall be provided with two separate seal oil chambers. The inner chamber shall be located between the motor and the gear reducer and the outer chamber shall be located between the gear reducer and the propeller. The anaerobic mixer shall have the outer chamber only between the motor and the propeller. Each mixer shall be provided with two (anoxic) or one (anaerobic) set(s) of independent mechanical seals running in an oil bath. The sealing system shall require failure of mechanical seals prior to moisture entering the motor.
- C. The two mechanical seals shall be interchangeable from one location to the other and each set shall have solid silicon carbide seal face material on both the stationary and rotating components. The metal components of the mechanical seal case shall be constructed of 316 stainless steel. A moisture sensor probe shall be furnished in the seal oil pre-chamber of each mixer. The sensor shall be wired to the control panel or motor control center and wired to shut down the motor if moisture is sensed.

2.05 MIXER SHOP TEST

- A. Each submersible mixer shall be given a factory test during which the mixer shall be run for a minimum of one-half hour. Tests shall show that the mixer has the general characteristics of amp draw, starting capability, and such other properties as appear on the approved submersible mixer shop drawings without overheating or excessive vibration.
- B. One copy of all test data shall be submitted with the Operation & Maintenance manuals. As a minimum, shop test results shall include the following information:
 - 1. Tests for each submersible mixer showing:
 - a. Mechanical and electrical integrity check established by physical inspection and by megger prior to applying power.
 - b. Power leads shall be applied and the motor started to verify proper rotation.
 - c. Mixer shall be run in the submerged condition to verify amp draw, starting capability, mechanical and electrical integrity.
 - d. After running, the unit shall again be checked by megger and by physical inspection.

2.06 MIXER PROPELLER AND SHAFT

- A. Mixer propellers shall be PUR (closed cell polyurethane resin) AND/OR ductile cast iron or steel that is resistant to chemical effects and provides the highest mixing efficiency due to the blade cross section. Welded steel or stainless steel propellers shall not be accepted. The propeller vanes shall be smooth, finished throughout, and shall be free from sharp edges. The surface of the propeller shall be free from defects and surface protrusions and shall be smooth. Propellers shall be statically and dynamically balanced.
- B. Propellers shall be statically and dynamically balanced after assembly to the rotor. Propellers shall be slip fit and securely held to the shaft by a stainless steel washer and bolt assembly that is enclosed in a separate hub chamber.
- C. The hub chamber is fitted with an O-ringed cap that seals the entrance of the propeller hub chamber device. The output shaft shall be splined to mate with the matching spline insert of stainless steel that forms the hub of the propeller. The arrangement shall be such that the propeller cannot unscrew or be loosened by torque from either forward or reverse rotation. Designs based on threaded connection between mixer shaft and impeller will not be considered.
- D. Mixer shafts shall be series 421 stainless steel with a minimum 1.375" diameter. Shafts shall be supported by bearings for axial and radial thrust and bearing life shall be designed to provide minimum B10 = 100,000 hours at design flowrate. All shafts shall be dynamically balanced and shall be amply sized to minimize shaft deflection. Shaft overhang shall not exceed 2.5 times the shaft diameter where it passes through the mechanical seal area and the overhang shall be the length of the shaft from the propeller side of the last bearing closest to the hub of the propeller.
- E. The engineer reserves the right to require submission of a sample of the output shaft detail drawing details to independently verify submittal calculations. Carbon steel shafts with or without shaft sleeves are not acceptable or equal to stainless steel.

2.07 MIXER MOUNT ASSEMBLY

- A. Each mixer shall be provided with a stainless steel mixer mount assembly to serve as a guide mast for the mixer during installation and to guide the mixer for removal from the liquid for service. The assembly shall consist of a minimum 3 inch by 3 inch tube and an upper and lower bracket constructed of stainless steel. The assembly shall also contain a stainless steel floor-mounted bracket to support and securely hold the mast assembly and shall allow horizontal rotation of the mast through not less than 120 degrees. The mast bearings shall be constructed of Teflon.
- B. The mast assembly shall be capable of proper operation with the mixer operating in any direction. The mixer mast shall be designed in such a way that the mixer can be lowered onto and off of the mast. The upper guide holder assembly shall secure the system to the top platform/wall and shall provide lateral support for the guide pile and a securing device for the electrical motor cable.
- C. Each mixer shall be provided with a crane assembly permanently located at the top of the basin over each mixer. The boom arm of the mixer shall be designed to properly reach and locate the mixer and to alter the angle of the mixer to assure proper mixing angles. The boom shall include a rotational turning handle and shall be capable of rotating a minimum of 360 degrees within the receiving box by means of a Teflon bearing. Each crane assembly shall include a winch and a minimum 1/4", 316 stainless steel lift cable with proper length to remove and set the mixer on the walkway. The winch assembly shall be capable of manual lift. All anchor bolts for the rail, mast and crane assembly shall be 304 stainless steel.

2.08 MIXER CASING AND COATING

- A. Casings shall be manufactured from ASTM A48 Class 35 or 40 close-grained cast iron. The outside contours of the mixer(s) shall be shaped to reduce hydraulic losses and to aid in mixing efficiency. Each casting shall be free from porosity, voids, casting fins, and other casting quality defects. The surface shall be smooth to the touch and free from all sharp edges and coated with ceramic base coating for chemical and abrasion resistance. Corners shall have smooth radius contours to avoid sharp edged corners and surfaces.
- B. The entire body of the mixer assembly shall be abrasive blasted to SSPC-SP10 with a minimum 2.5 mil profile. The mixer shall then be immediately coated with a minimum of 15 mils of Ceramic compound. The Ceramic compound shall be a two-part polymer/ceramic design for airless spraying, cold-curing, solvent free and include reinforcing with special fillers and extenders. The corrosion resistance below the surface of the coating shall be capable of withstanding ASTM salt spray test for over 3000 hours. Epoxy, enamel coatings or stainless steel sheet covering a cast iron body will not be considered as equal to the specified coating system and will not be accepted.

2.09 MIXER SPARES

- A. The units shall be supplied with the following spare parts:
 - 1. One (1) set of bearings, one (1) set of mechanical seals set, and one (1) set of O-rings.

2.10 EQUIPMENT CONTROLS

- A. All equipment used to control the Carrousel BNR Control System shall be supplied by the Carrousel BNR System manufacturer. This is to keep continuity and single source responsibility for the entire system.
- B. The controls shall be designed to provide high reliability. The Carrousel BNR System manufacturer shall provide the programming with logic functions to match the process and operational requirements of the system. The controller shall allow the system to operate the equipment without excessive speed.
- C. The control panel(s) shall be located in a climate controlled building
- D. CONTROL PANEL
 - 1. The Bio-P Control System shall be integrated in a NEMA 1 gasketed MCC configuration. A 480V - 3Ø 60Hz feed is required. A main disconnect with security lock-out shall be included. The aerator VFD(s), and all BNR motor starters by others, integrator to coordinate and provide all communication between VFDs and motor starters and BNR/Bio-P control panel. A panel board section shall be provided to allow for power distribution to Control System Instrumentation and BNR motor oil immersion heaters if needed. The MCC shall conform to UL845. The PLC control panel of the MCC shall conform to UL508A.
 - 2. Programmable controller (PLC)
 - a. The PLC shall be Allen Bradley CompactLogix 1769-L30ER, with discrete inputs and outputs. The CompactLogix shall be backed by a Compact Flash.
 - b. Discrete input cards shall be rated for 120V and be equipped with 16-points per card. Discrete input cards shall be Allen Bradley 1769-IA16.
 - c. Discrete output card shall be relay-type, rated for 120V and be equipped with 16-points per card. Discrete output cards shall be Allen Bradley 1769-OW16
 - d. Analog cards shall be rated 4-20 mA. Each input shall be protected by a surge protection device. Analog cards shall be 1769-IF8
 - 3. Human Machine Interface (HMI)
 - a. The HMI shall be a 15-inch TFT color touch screen, industrial operator interface.
 - b. The HMI shall have one USB port and one Ethernet port.
 - c. The HMI shall be Allen Bradley Panel View Plus
 - 4. Terminal Blocks
 - a. The terminal blocks used in the BNR Control Panel will be as specified in the BNR section and supersedes other terminal block specifications.

- b. Power Terminals: Unit construction type with closed back tubular pressure screw connectors, rated 600 volts
- c. Signal and Control Terminals: Modular construction type, suitable for channel mounting, with spring type connectors, rated 300 volts.

E. OPERATION

- 1. The HMI shall allow the operator the ability to modify the following, but not limited to, setpoints and parameters for the operation of the system:
 - a. VFD speed adjustment.
 - b. D.O. loop setpoints and limits.
 - c. Aerator adjustment delay.
 - d. ORP loop setpoints and limits.
- 2. The HMI shall provide to the operator the following, but not limited to, monitoring parameters:
 - a. Real time VFD speed(s).
 - b. Real time D.O. level(s).
 - c. Real time ORP level(s).
 - d. Aerator status.
 - e. Mixer status.

F. CONTROL

- 1. Aerator power input shall be adjusted to match process oxygen demands using Dissolved Oxygen (D.O.) concentration as the primary control parameter. The D.O. level will be monitored at the location shown on the plans.
- 2. The D.O. signal shall be used to pace the VFD in "Auto" operation. In "Manual" the operator shall be able to control the speed manually by using the HMI.
- 3. Proper velocity shall be maintained while running in Auto operation.
- 4. The D.O. levels shall have defined limits that shall be user-defined but factory preset. The factory set algorithms shall be the responsibility of the BNR system supplier and shall be specifically designed for the installed system.
- 5. The entire system shall be designed to restart after power outage if no alarm conditions are present that would normally shut the unit down.

6. The aerator OFF time shall be monitored and an exercise alarm activated when a unit needs to be operated for warranty purposes.
7. The BNR Control System shall adjust the pumping rate for the mixed liquor recycle pump for ORP control.
8. The BNR control system shall include a mixed liquor recycle pump flow control override to prevent hydraulically overwhelming piping conduits or backing-up the anaerobic basin to interfere with flow monitoring in the headworks building. The override shall limit mixed liquor recycle flow in response to increasing influent flows to limit total flow to the anaerobic basins to an operator-adjustable setpoint (over-riding normal recycle flow rate ORP feed-back control).
9. Monitoring points shall be available to the SCADA system via Ethernet. The points shall include:
 - a. Aerator speed reference (Hz).
 - b. Aerator alarm status.
 - c. D.O. reference.
 - d. D.O. setpoint.
 - e. D.O. alarm status.
 - f. ORP reference.
 - g. ORP setpoint.
 - h. ORP alarm status.
 - i. Mixer status. (4 mixers including 3 existing)
 - j. Mixed Liquor Recycle pump speed reference
 - k. Mixed Liquor recycle pump alarm status
 - l. Mixed Liquor flow rate as measured by magnetic flow meter.

G. INSTRUMENTATION

1. Analyzer
 - a. The Analyzer shall be a microprocessor based instrument. Connections between the probe sensor and the controller shall be “plug-and-play” without requiring extensive programming or configuration. The system shall be able to perform automatic calibration of the dissolved oxygen monitoring system.

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- b. The controller shall have wireless downloading capability through an IR port located on the controller unit to download and print real time data, calibration history and current set points in a CSV format.
 - c. The controller unit shall allow control of the sensor and interface functions using menu driven software. The interface unit shall have a built-in data logger with the capacity to store data on 15-minute intervals for up to 6 months. The display for the unit shall be a graphic dot matrix LCD display, 128 x 64 pixels with LED backlighting. All user settings for the controller shall be retained indefinitely in non-volatile memory (EEPROM)
 - d. The controller unit shall include two analog 4 to 20mA output signals proportional to dissolved oxygen level and temperature, and shall include two independent PID control functions including high/low phasing, setpoints, dead bands, off delay and on delay.
 - e. The unit shall include three (3) SPDT, user configurable Form 'C' alarm contacts, rated at 100 to 230 volts AC, 5 amp resistive maximum. The unit shall be capable of providing the following alarm conditions: low alarm setpoint, low alarm point dead band, high alarm setpoint, high alarm point dead band, off delay and on delay.
 - f. The controller unit shall be housed in a NEMA 4X enclosure with a corrosion resistant finish. The AC power supply to the unit shall be housed in the interface unit and shall automatically accept input in the range of 100 to 230 volts AC, single phase, 60 Hz. The interface unit shall be supplied with a sun shield. The unit shall be capable of exterior mounting, vertically on the handrail.
 - g. The Controller shall be HACH Model SC 200 Controller as manufactured by the Hach Company.
2. Dissolved Oxygen Probe:
- a. The Dissolved Oxygen (D.O.) Probe shall be a continuous reading probe that utilizes luminescent sensor technology.
 - b. The probe material shall be foamed Noryl® and Type 316 stainless steel. All parts of the probe shall be corrosion resistant and fully immersible. The D.O. sensor material shall be polybutyl methoacrolate.
 - c. The measurement range of the probe shall be 0.00 to 20.00 mg/L dissolved oxygen and 32.0 to 212.0° F (0.0 to 100.0° C) temperature. The operation of the probe/analyzer shall not be affected by H₂S, pH, metals and salts normally found in domestic wastewater. The probe shall provide for electrolyte-free operation without the requirements of sample conditioning.
 - d. The probe shall not require periodic membrane changing. The sensor cap shall be easily replaceable and cleaning accomplished by periodically wiping the sensor with a clean rag. The accuracy of the sensor shall be ±0.1 mg/L for levels less than 1.0 mg/L and ±0.2 mg/L for D.O. levels greater than 1.0 mg/L. The

sensitivity of the probe shall be $\pm 0.5\%$ of the span and the repeatability of the probe shall be $\pm 0.5\%$ of the span. The response time of the probe shall be 1 to 60 seconds to 90 percent of the value upon a step change in D.O.

- e. The D.O. probe shall be the HACH LD.O.® Probe for dissolved oxygen and temperature measurement as manufactured by the Hach Company.

3. ORP Probe

- a. The ORP sensor shall be of Differential Electrode Technique design using two measuring electrodes to compare the process value to a stable internal reference standard buffer solution. The standard electrode shall have non-flowing and fouling-resistant characteristics.
- b. The sensor shall have a hex-shaped body to facilitate mounting, and shall be constructed of Ryton® material for exceptional chemical resistance and mechanical strength. This material shall enable the sensor to be installed in metal fittings without leakage usually caused by heating and cooling cycles when dissimilar materials are threaded together.
- c. The sensor shall have a convertible body style featuring 1-inch NPT threads on both ends to mount into a standard 1-inch pipe tee, into an adapter pipe for union mounting with a standard 1-1/2 inch tee, or onto the end of a pipe for immersion into a vessel.
- d. The built-in electronics of the sensor shall be completely encapsulated for protection from moisture and humidity.
- e. The sensor shall have a built-in preamplifier to enable the signal to be transmitted up to 100 m (328 ft.) with standard cabling and up to 1000 m (3280 ft.) with a termination box.
- f. The ORP sensor shall include a titanium ground electrode (standard) to eliminate ground loop currents in the measuring electrodes.
- g. The ORP sensor shall be Hach Ryton ORP measurement sensor as manufactured by the Hach Company.

H. Probe Mounting:

1. D.O. / ORP Probe

- a. The Probe(s) shall be provided with a mounting system capable of being attached to hand railing. The Probe(s) shall be attached to an arm that is suspended in the basin. The arm shall be manufactured of Schedule 80 PVC pipe and fittings and furnished by the installing contractor.
- b. The swivel bracket that attaches the arm to the hand railing shall be fabricated of Type 316 stainless steel. All nuts, bolts, washers and other hardware used to mount the pole to the swivel bracket and to mount the bracket to the hand railing, shall be furnished.

- c. The Probe mounting bracket shall be constructed to allow for easy calibration or exchange of the Probe without the use of tools.

I. MIXER MOTOR STARTERS

1. Mixer motor starters by others.
2. Mixer motor starter shall be NEMA rated with Electronic Overload Relays. The overload relays shall provide critical motor protective functions
 - a. Thermal overload
 - b. Phase loss
 - c. Ground fault
 - d. Stall / Jam
 - e. Underload
 - f. PTC thermistor monitoring
 - g. Current imbalance
3. Mixer motor overload relays shall perform true RMS current sensing and shall include integrated I/O. The overload relays shall include diagnostic functions.
 - a. Motor diagnostics
 - b. Preventative maintenance diagnostics
 - c. Motor current monitoring
4. The Electronic Overload Relays shall have Ethernet/IP communications. They shall be Allen Bradley bulletin 193/592 E300 Relays.

J. VARIABLE FREQUENCY DRIVES

1. The Variable Frequency Drive (VFD) system shall contain all components required to meet the performance, protection, safety and certification criteria of this specification.
2. The BNR VFD(s) shall be by others (not the Bio-P removal control and equipment supplier). Contractor to coordinate all scope of supply items with suppliers.
3. The VFD(s) shall be located in the electrical room in a climate controlled building.
4. The VFD(s) shall allow for internal monitoring and control of specific BNR aeration equipment. These signals shall include but not limited to:
 - a. Oil pressure monitoring

- b. Motor thermal overload monitoring
- 5. The VFD(s) shall be 6-pulse.
- 6. Hardware
 - a. Utilize diode bridge or SCR bridge on the input rectifier.
 - b. Utilize switching logic power supply operating from the DC bus.
 - c. Incorporate phase to phase and phase to ground MOV protection on the AC input line.
 - d. Microprocessor based inverter logic shall be isolated from power circuits.
 - e. Utilize latest generation IGBT inverter section.
 - f. Inverter section shall not require commutation capacitors.
 - g. Ethernet port for direct network cable connections.
 - h. Battery receptacle for Lithium battery power to the Real Time Clock.
 - i. Additional DPI port for handheld and remote HIM options.
 - j. Dedicated Digital Input for hardware enable.
 - k. Optional onboard 24V DC Auxiliary Control Power Supply
- 7. Control Logic
 - a. Ability to operate with motor disconnected.
 - b. Provide a controlled shut down, when properly protected, with no component failure in the event of an output phase to phase or phase to ground short circuit. Provide annunciation of the fault condition.
- 8. Power Conditioning
 - a. Designed to operate on an AC line which may contain line notching and up to 10% of voltage harmonic distortion.
 - b. An input isolation transformer shall not be required for protection from normal line transients.
- 9. Current Limit
 - a. Programmable current limit.
 - b. Current limit shall be active for all drive states: accelerating, constant speed and decelerating.

- c. The drive shall employ PI regulation with an adjustable gain for smooth transition in and out of current limit.
10. Flying Start
- a. The drive shall be capable of determining the speed and direction of a spinning motor and adjust its output to "pick-up" the motor at the rotating speed.
11. Inputs and Outputs
- a. The Input / Output option modules shall consist of both analog and digital I/O.
 - b. No jumpers or switches shall be required to configure digital inputs and outputs.
 - c. All digital input and output functions shall be fully programmable.
 - d. The control terminals shall be rated for 115V AC.
 - e. Inputs shall be optically isolated from the drive control logic.
 - f. The control interface card shall provide input terminals for access to fixed drive functions that include start, stop, external fault, speed, and enable.
12. Ratings
- a. Voltage
 - i. Capable of accepting nominal plant power of 480V AC at 60Hz.
 - ii. The supply input voltage tolerance shall be $\pm 10\%$ of nominal line voltage.
 - b. Displacement Power Factor
 - i. Capable of maintaining a minimum true power factor (Displacement P.F. X Distortion P.F.) of .95, lagging, over the entire speed range.
 - c. Efficiency
 - i. A minimum of 96.5% (+/- 1%) at 100% speed and 100% motor load at nominal line voltage.
 - ii. Control power supplies, control circuits, and cooling fans shall be included in all loss calculations.
 - d. Operating ambient temperature range without derating: 0 °C to 40 °C (32 °F to 104 °F)
 - e. Operating relative humidity range shall be 5% to 95% non-condensing.
 - f. Operating elevation shall be up to 1000 Meters (3,300ft) without derating.

13. The VFD shall be rated at Heavy Duty loads and shall provide 150% overload capability for up to one minute and 180% for up to 3 seconds.
14. Communications
 - a. VFD shall provide an Embedded EtherNet/IP port.
15. Enclosure Door Mounted Human Interface Module (HIM)
 - a. VFD shall provide a HIM with integral display, operating keys and programming keys.
 - b. The HIM shall be rated NEMA/ UL Type 4/12 panel mounting that is connected via cable.
 - c. The display portion shall have the following features:
 - i. The display shall be a seven (7) line by twenty-one (21) character backlit LCD display with graphics capability.
 - ii. The display shall show drive operating conditions, adjustments and fault indications.
 - iii. The display shall be configured to display in three distinct sections.
 - iv. The first section shall be a status display for direction, status, fault / alarm conditions and Auto / Manual mode.
 - v. The second section shall display drive output frequency.
 - vi. The third section shall be configurable as a display for either programming menus / information or as a two-line user display for two additional values utilizing scaled units.
 - vii. The Human Interface shall provide digital speed control.
 - viii. The keypad shall include programming keys, drive operating keys (Start, Stop, Direction, Jog and Speed Control), and numeric keys for direct entry.
16. Enclosure
 - a. Shall be rated UL Type (12).
 - b. Shall be painted per the manufacturer's standard.
 - c. Shall provide entry and exit locations for power cables.
 - d. Shall contain a label for UL508.

- e. The drive system nameplate shall be stamped with SCCR ratings inside the enclosure.
17. Drive Input Disconnect
- a. VFD shall provide a door interlocked fused disconnect switch
 - b. Operator Handles
 - i. Provide externally operated handles for disconnects.
 - ii. Handles shall be lockable.
18. Control Power Transformer
- a. Provide a control power transformer mounted and wired inside of the drive system enclosure.
 - b. The transformer shall be rated for the VFD power requirements.
19. Auxiliary Relays
- a. Provide relays for Drive Alarm, Drive Fault, Drive Run, and System Status Faults (as required).
 - b. The relays shall be Allen-Bradley 700-HC (2 N.O. & 2 N.C.) or equal. The relay contacts shall be rated for 115V AC/30V DC, 5.0 amp resistive, 2.5 amp inductive.
20. Control Interface
- a. The control terminals shall be rated for 115V AC.
 - b. Inputs shall be optically isolated from the drive control logic.
 - c. The control interface card shall provide input terminals for access to fixed drive functions that include start, stop, external fault, speed, and enable.
21. Motor Heater Control
- a. The drive system shall provide the drive control circuitry to energize an existing motor heater whenever the motor is not running.
 - b. The heater control shall be interlocked with the drive and/or bypass and shall be energized whenever the motor is not running.
 - c. The device shall be an Allen-Bradley Bulletin 800T [30mm] NEMA Type 4/13 or equal, mounted on the drive system enclosure door.
- K. In the event of improper installation, the Contractor and the manufacturer shall be responsible for supervising the correction of the work and subsequent test runs until the defects are corrected.

3.00 WARRANTY

3.01 INSTALLATION

- A. Manufacturer of the BNR/Bio-P control system shall have a trained and qualified representative on-site to check the installation, including data connections and calibration of instruments. Certificate of Installation and Testing, as required in specification section 01 75 00 shall be submitted by manufacturer's start-up representative.

3.02 TRAINING

- A. Meet all requirements of specification section 01 75 00.
- B. In addition, Qualified manufacturer's representative shall provide a minimum of 12 hours (over no less than 3-days time) specific, practical instruction to the Owner's personnel on the biological phosphorus removal process being employed in this project, include instruction on the following and all other conditions relevant to this project that the operator should be aware of to achieve the highest level of performance possible:
1. Biological phosphorus removal theory and its application to this project.
 2. Parameters monitored using this particular biological phosphorus removal system and control system's response.
 3. Monitoring parameters outside of on-line instrumentation that are recommended to collect sufficient data to reliably trouble-shoot the system's performance.
 4. Optimization techniques for variable loading conditions.
 5. Overview of other plant activities that must be monitored and recommendations for control in order to optimize the biological phosphorus removal process. For example:
 - a. Dewatering scheduling and filtrate return, impacts and recommendations.
 - b. Sidestream return from tertiary filtration processes. Impacts of scheduling and recommendations.
 - c. Addition of metal salts in the secondary clarifiers to improve performance prior to filtration – impacts of aluminum salts in the RAS to the biological treatment process, with recommendations.

3.03 FIELD SERVICE TOTAL TIME

- A. Manufacturer's trained and qualified representative shall spend a minimum of 8 total days on site in two (2) trips to do all commissioning, testing, startup, calibration, certification, and training for the controls system required herein.
- B. Manufacturer's trained and qualified representative shall include an additional one (1) trip of up to two (2) days on site for commissioning, startup, certification, and training for the submersible mixer.

3.04 FOLLOW-UP SUPPORT

- A. Controls system supplier shall offer free and unlimited telephone and on-line support for operating the BNR system for a minimum of one year after project acceptance to include help with trouble-shooting and optimization.

3.05 WARRANTY

- A. The equipment supplier shall warrant that its equipment shall be free from defects in material and workmanship; and that it will replace or repair, F.O.B. its factory, any part or parts returned to it which examination shall show to have failed under normal use and service by the user within eighteen (18) months following initial shipment or twelve (12) months following operation start up, whichever occurs first.

****END OF SECTION****

1.00 GENERAL

1.01 RELATED DOCUMENTS

- A. 43 41 43 Vertical HD XLPE Process Tanks
- A. 46 33 33 Polymer Blending and Feed Equipment
- B. 46 33 44 Chemical Metering Systems
- C. 46 41 11 Flash Mixer
- D. 46 41 34 Flocculators

1.02 DESCRIPTION OF WORK:

- A. Contractor to furnish all labor, materials, equipment and incidentals required for the automatic backwash filter system as shown on the drawings and as specified herein, installed, tested and ready for operation.
- B. Each Discfilter shall consist of a central drum onto which the discs with the filter media panels are assembled. The rotating filter drum is supported on the front by two support wheels and at the rear by a central bearing. Each filter unit shall include center drum, discs with filter media panels, support frame with cover, backwash spray assembly with pump, backwash trough, drive mechanism, automatic control system and components as specified.
- C. Filter shall be designed for installation as shown on the contract drawings/plans.

1.03 QUALITY ASSURANCE:

- A. To assure unity of responsibility, center tube, discs with filter media panels, support frame with cover, backwash spray assembly with pump, backwash trough, drive mechanism, automatic control system and components as specified shall be furnished and/or coordinated by a single manufacturer.
- B. All painting shall be per Manufacturer's standards.
- C. Experience of Equipment Manufacturers:
 - 1. It is the intent of the contract documents to procure the best equipment and services that are available. The filtration equipment shall be furnished by a manufacturer who shall have at least fifteen (15) years experience in the United States or twenty (20) years experience elsewhere in the design, production, assembly and field service of equipment of like type, size and capacity in similar applications. The equipment manufacturer must supply a list of at least one hundred (100) successful installation sites in the United States utilizing equipment of like type in similar applications.
 - a. A minimum of five (5) of the installations provided in the list supplied by the manufacturer shall be in an application removing phosphorus from the treated wastewater effluent from secondary biological facilities treating primarily domestic wastewater.

- b. The phosphorus removal applications of this equipment shall include upstream pre-treatment utilizing chemical precipitation, where sizing and requirements of the pre-treatment train was primarily the responsibility of the filter manufacturer.
2. The equipment supplier must have manufacturing or warehouse facilities located in the United States including parts inventory, and personnel based in the United States and employed by the supplier to provide direct technical and field support. The equipment manufacturer must provide information supporting their ability to provide these services.
3. The disc filtration technology shall be accepted filtration technology for compliance with the State of California Water Recycling Criteria (Title 22).

D. Acceptable Manufacturer:

Veolia Water Technologies, Inc. dba Kruger or preapproved alternate. Preapproval of an alternate shall follow process outlined in Article 11 of the Instructions to Bidders.

The Plans have been prepared based on the dimensions and capabilities of Veolia Water Technologies, Inc. dba Kruger.

E. Pre-approval of equal Alternate Manufacturer(s):

1. Alternate manufacturers wishing to be preapproved must follow the process outlined in Article 11 of the Instructions to Bidders. The following items are recommended to be included in the request for approval in order to meet the burden of proof of the merit of the proposed alternate, and for the Engineer to consider the proposed alternate as potentially “or-equal” and worthy of preapproval.
 - a. Detailed layout drawings
 - b. Detailed component specifications and catalog cut-sheets.
 - c. Process P&ID Sheet with written description of each instrument and its function. P&ID sheet shall be specific to the Leavenworth wastewater treatment plant, including all non-standard control elements required for this installation.
 - d. Detailed list of appurtenance equipment which is required to be supplied by the filter supplier according to this specification section and any other drawings or specification notes.
 - e. Detailed list of variations from the design depicted in these documents, referencing appropriate sections of the Specifications and locations on the drawings. The preferred format of the list of variations is as follows:
 - 1) Photocopied specification section 46 61 33 and all other specification sections for equipment to be supplied by the filter system manufacturer, with each paragraph of each section marked to indicate the proposed alternate equipment will fully comply with that paragraph.

- 2) Marked-up copies of bid plans (drawings) clearly indicating all variances.
 - f. History of the process offered, with pilot and full-scale operational data and experience, demonstrated by a minimum of 5 full-scale installations of the process and configuration specified herein and shown on the drawings, in successful operation for a period of at least 5 years each). The 5 installations must include application of the process for the specific purposes of removing phosphorus from treated wastewater effluent, with pre-treatment consisting of chemical addition, rapid mix, coagulation, and flocculation to precipitate of phosphorus to inorganic solids capable of removal using the proposed f discfilters, with influent and effluent conditions comparable to the Leavenworth application. The installation list shall include contact names and phone numbers to allow verification of installation details.
 - g. Certification indicating the proposed disc filtration technology is accepted filtration technology for compliance with the State of California Water Recycling Criteria (Title 22).
 - h. Alternate bidders shall guarantee, in writing, signed by an officer of the company, that the equipment offered will provide comparable or superior features, performance quality, and materials of construction as the equipment specified.
 - i. Written guarantee indicating full compliance with the process performance requirements of paragraph 1.5 and the performance guarantee on paragraph 4.2. Any exceptions to the performance guarantee must be clearly indicated, and may be grounds for rejection.
- F. The Equipment Manufacturer shall warrant the use of this system and its equipment will not infringe on any U.S. or foreign patent.

1.04 SUBMITTALS

- A. Submit as specified in Division 01
- B. The Contractor shall furnish shop drawings, catalog data, operation and maintenance manuals, installation instructions, parts list, layout drawings, equipment design data, testing data and reports to show full compliance with these specifications.

1.05 PERFORMANCE REQUIREMENTS

- A. The Discfilter System shall be capable of meeting the following performance requirements.

AUTOMATIC BACKWASH DISCFILTER

Performance Criteria, System	Value
Peak Flowrate, MGD* (gpm)	1.35
Maximum Influent TSS*, mg/L	≤ 35
Average Influent TSS*, mg/L	≤ 20
Monthly Average Effluent TSS*, mg/L	≤ 5
Maximum Influent Total P*, mg/L	≤ 1.5
Maximum Influent Soluble Non-Reactive P*, mg/L	≤ 0.05
Monthly Average Effluent Total P*, mg/L	≤ 0.1
Filter Design Data	
Filter Pore Size, μm	10
Filter Cloth Material	Polyester
Number of Units	2
Number of Filter Discs per unit	6
Filter Disc Diameter, m	2.2
Effective Filter Surface Area per unit, ft ²	235
B. Filter Drive Unit	
Drive Motor (1 per unit)	1.5 HP, 460v, 3 phase
Drive Assembly	Drive Chain and Sprocket
1. Backwash Cleaning System	
Number of Backwash Nozzles (per Disc)	10
Backwash Pump (1 per unit)	7.5 HP, 460v, 3 phase
Backwash Pressure, psi	110
Design Backwash Flowrate, gpm	41

*The equipment manufacturer shall provide additional operational instruction and training to optimize performance and capacity even if influent characteristics fall outside stated limits. Performance requirement guarantee (paragraph 4.2) are valid when influent characteristics lie within the limits shown. Average TSS and TP concentrations are based on analysis of 24 hr composite samples.

- C. The automatic backwash filter system shall be suitable for filtering domestic wastewater after secondary treatment and clarification. Each filter shall be designed to operate on a continuous basis and shall be designed to operate while receiving varying flows.
- D. The proposed disc filtration system shall not exceed a hydraulic loading rate of 3.99 gpm/sf at peak flow.
- E. Filtration system shall utilize an “inside-out” flow pattern in which influent flows by gravity into the filter discs from the center drum. Solids are separated from the water by partially submerged filter media. Filtration systems with fully submerged media utilizing an “outside-in” flow pattern shall not be acceptable due to accumulation of solids in the tank, resulting in a dirty and unsanitary work environment for the plant operation staff.

- F. In order to minimize electrical and operation costs, filtration systems that employ a “dynamic tangential filtration” design shall not be accepted.

2.00 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. All fabricated metal shall be minimum grade AISI 304 stainless steel, unless otherwise stated in this specification. Filter panels shall be polyester filter cloth mounted on plastic frames with integrated rubber seals. Filter disc segments shall be injection molded ABS plastic. Discfilter designs utilizing cassettes with fiberglass molded frames shall not be acceptable.
- B. The valves, equipment, materials of construction and controls specified under this section supersede valves, equipment, materials of construction and controls specified elsewhere in the contract documents. Purchased components such as gear reducers, pumps, motors, valves, and actuators shall be provided with standard recommended manufacturers paint, unless otherwise specified within this section.
- C. The disc filtration units shall be fully preassembled and factory inspected prior to shipping the filtration units. Drive motor and backwash pump are to be installed at factory and provided integral to filtration unit.
- D. Flange connections to be provided with AISI 304 stainless steel stub ends and loose galvanized flange collar rings.
- E. Approximate operating weights are as follows:
 - HSF 2206-1C: (Shipping Weight) 6,500 lbs.
 - (Full of Water) 26,100 lbs.

2.02 CENTER DRUM

- A. The center drum shall be a water tight, one piece, structural welded, AISI 304 stainless steel fabrication, open at one end to allow the influent to enter, and have openings to the filter discs for water distribution to the filter media. The center drum shall have lubricated roller wheels and bearings, which must be externally accessible via grease tubing and fittings for routine lubrication.
- B. Revisions to standard grease tubing arrangement shall be made by the manufacturer, at no additional cost to the owner, if necessary to make the grease fitting easily accessible without the need to remove any equipment or access walkways as shown in the contract drawing.

2.03 DISC ASSEMBLY

- A. The filter shall be composed of modular and removable discs. Each disc shall consist of disc segments that can be easily mounted or dismounted as required. The segments of one disc will be bolted to each other, and the completed disc assembly will be secured to the center drum with stainless steel band straps and hardware. Designs utilizing disc cassettes shall not be acceptable due to excessive amount of media that is to be replaced when media panel(s) are torn or broken.

- B. Filter panels (filter media) shall be mounted on the sides of the disc segments. The filter panels shall consist of plastic frames with PET monofilament filter fabric attached to the frames. Systems with pleated media, corrugated media, pile cloth media, or stainless steel media shall not be acceptable. Stainless steel media shall also not be accepted due to its susceptibility to corrosion and short life span caused by mechanical fatigue failure. Each panel shall be equipped with an EPDM rubber gasket that is fitted to and provided integral to the media frame to provide a watertight seal between the filter panels and disc segments. The panels will be held in place by a top cover. Designs that utilize stick-on adhesive compressible gaskets as seals between the media panels or between disc cassettes shall not be accepted due to lack of durability and potential for compromised effluent quality.
- C. Nominal media pore size shall not exceed 10 microns. Filtration systems utilizing media greater than 10 microns shall not be accepted.
- D. The replacement of filter media must be possible from outside the filter tank by unfastening two bolts, removing the retaining cap and sliding panels from filter frame.
- E. Filter discs must be constructed of modular segments and each disc segment must include a substantially open area along the length of the radial support to allow the liquid to flow from one section to the other as the discs are rotated.

2.04 SUPPORT FRAME WITH ENCLOSED TANK AND COVER

- A. The support frame and tank shall be one piece, structural welded, 304 stainless steel. Onto the support frame shall be welded 304 stainless steel base plates for back-wash pump, drive gear box, and center shaft bearing house. Tank thickness shall be a minimum of 1/8" thickness. Carbon steel construction shall not be acceptable in order to minimize maintenance efforts associated with corrosion and painting.
- B. The filter shall be furnished with a GRP (Glass fiber Reinforced Plastic) lockable cover as a means to prevent algal growth and to eliminate the presence of filter flies. One side of the cover shall have a single access lid that can be opened to allow operator access to all of the discs and backwash nozzles. Designs that require both sides of the filter cover(s) to be opened in order to access filter media and/or backwash nozzles shall not be acceptable due to operator inconvenience and the requirement for additional footprint and access platform. Single-access (main) lid shall be on the side of the filter unit to allow access from the catwalk system indicated in the drawings. The lid must include an assembly that provides the following: mechanical advantage to assist personnel in lifting the lid, full support of the lid when in the open position, and mechanical resistance/support when lowering the lid. This feature is important for ease of access and improved operator safety. Designs that incorporate removable lids, sliding lids, or propped lids (without mechanical lifting mechanism) will not be accepted.
- C. Anchor bolts shall be provided by the contractor.

2.05 BACKWASH CLEANING SYSTEM

- A. The Discfilter shall be equipped with a single oscillating back-washing system with non-motorized moving spray headers for efficient cleaning of the filter cloth and for reduction of the consumption of backwash water. All panels shall receive 110 psi pressure backwash spray. Systems with separate solids removal and backwash discharge systems shall not be acceptable.

- B. The backwash system shall be comprised of 304 stainless steel backwash spray headers installed between the discs. The spray headers shall oscillate in an upward and downward motion during drum rotation. The spray header oscillation shall be operated by a cam system that is connected to the drum drive. Systems with stationary spray headers or with separate drive motors to oscillate the spray headers shall not be acceptable. Each header shall have flat pattern spray nozzles for each disc side. The spray nozzles shall consist of self-cleaning nozzle tips, mounting cap for quick removal, nozzle body and seals. The replacement of spray nozzles must be possible from outside the filter tank. A swivel joint shall allow the spray header manifold to rotate out for nozzle access without disassembly of the manifold or headers.
- C. Each filter shall have one externally mounted low-pressure Grundfos Model CR15-5 centrifugal pump for the backwash system and shall be installed at the factory. The backwash pump shall be provided integral to the Discfilter unit. The backwash pump shall be of the vertical multi-stage design with the motor mounted directly to the top of the pump. The pump suction and discharge fittings shall be ANSI flanged, 2" fittings. The pump suction/discharge chamber, motor stool and pump shaft coupling shall be constructed of cast iron. The impellers, pump shaft, diffuser chambers, outer discharge sleeve and impeller seal rings or seal ring retainers shall be constructed of stainless steel. The impellers shall be secured directly to the pump shaft by means of a splined shaft arrangement. Pump shall be equipped with a balanced cartridge type mechanical seal assembly with Silicone Carbide seal faces and EPDM rubber O-rings mounted in stainless steel components. The motor shall be supplied by Grundfos integral with the pump. The motor shall be standard efficiency rated for 7.5 HP, 460V, 3 phase, 60 HZ operation and shall be NEMA C face design, Totally Enclosed Fan Cooled (TEFC) with a minimum service factor of 1.15. Filtered water shall be pumped via a 304 stainless steel suction pipe and discharged from the pump to the backwash header piping constructed of 304 stainless steel. A pressure gauge shall be installed in the backwash header piping downstream of the pump in order to monitor the nozzle pressure.
- D. The Discfilter shall be equipped with a backwash-collecting trough for removing solids. The trough shall be constructed of 304 stainless steel. The trough length shall be sufficient to capture reject water from all filter discs. The trough shall be elevated to prevent contact with the influent stream. The reject water shall leave the trough by gravity via the backwash outlet connection. Piping from the trough to the outlet connection shall be 304 stainless steel connected with stainless steel shielded, flexible elastomeric PVC couplings. The backwash outlet connection shall be a 6 inch ANSI loose flange. Systems with separate solids removal and backwash discharge systems shall not be acceptable.

2.06 DRIVE MECHANISM

- A. A drive assembly shall be incorporated to rotate the center tube/disc assembly during the backwash cycles.
- B. The drive assembly shall consist of a gear motor, non-corrosive lubricated steel chain and sprockets. Any design using a belt drive assembly will not be accepted for use. The gear motor shall be SEW Eurodrive shaft mounted helical worm gear with integral standard AC induction motor, SEW gear motor model S77DRN90S4. The gear ratio shall be 189.09. The motor shall be rated for 1.5 HP, 460V, 3 phase, 60HZ operation.
- C. The drive assembly shall also provide oscillation of the backwash spray headers without the need for a separate drive motor in order to provide for efficient cleaning of the filter media with minimal water usage and minimal energy usage. Systems with stationary spray headers and/or

separate drive motors shall not be acceptable for use.

- D. Reducer design end rating shall equal or exceed AGMA requirements. Speed reducers shall be selected for not more than AGMA class I service.
- E. The drive sprockets are manufactured of carbon steel driven by a steel chain. The drive chain must not operate in submerged or wetted environment. Any design that allows the chain to come into contact with the inlet water or the filtrate shall not be accepted for use.

2.07 FLOW BYPASS

- A. A bypass chamber shall be supplied integral to the filter unit to allow for diversion of unexpected high inlet water level, preventing bypass water from entering the filtered water chamber of the Discfilter unit. The bypass chamber shall be at the inlet side of the filter unit. Bypass water will exit via effluent flange.

2.08 AUTOMATED CLEANING SYSTEM (ACS)

- A. The equipment manufacturer shall furnish an automatic cleaning system that applies a chemical spray to the media in order to remove either organic or inorganic foulants. The system must be integrated into the design of the filter system and must include spray nozzles, chemical storage tank(s), chemical dosing pump(s) with variable speed control (VFD), and other appurtenances as required for automated operation. The system must allow for operations staff to simply engage the system and initiate operation at the unit. The system must be initiated to begin the cleaning cycle from the HMI and/or selector switches located on the front of the filter unit control panel. Once initiated, the system must provide for media cleaning while being fully automated from the control panel. System must provide spray application of chemical to the filter media and may not depend on use of "soak" or "bath" techniques for media cleaning. Equipment manufacturer must demonstrate that the system has been designed and implemented in previous Discfilter installations for chemical cleaning. The automatic cleaning system and controls shall be provided by the Discfilter equipment supplier.

2.09 DISCFILTER CONTROL PANEL AND OPERATION

- A. The Discfilter operation shall be managed by an automated control system. The automatic control will be designed around an Allen Bradley Micro850 Programmable Logic Controller.
- B. The control system is an integral part of the Discfilter system and shall be provided in a UL labeled, NEMA 4X 304 Stainless Steel enclosure. Each Discfilter unit shall include a control system which shall consist of a programmable controller, fused main disconnect, control transformer, branch circuit breakers, IEC motor starter/protector, hand-off-automatic switches, and liquid level sensor relay for initiating backwash. The power feed to the control panel shall be 480VAC 60Hz 3 phase, control voltage shall be 120VAC 60 Hz 1 phase.
- C. The control panel enclosure shall meet the following criteria, 304 Stainless Steel, seams continuously welded and ground smooth, seamless foam-in-place gasket for watertight dust-tight seal, door opens 180°, quarter turn latches opened or closed using a screw driver, and NEMA Type 4X , UL Listed 4X. Saginaw SCE42EL3612SSLP or approved equal.
- D. The main disconnect shall be enclosed in the control panel, with a handle mechanism extending through the door. The main disconnect shall be a fused disconnect rated for 30 Amps 3-Pole.The

main disconnect shall be composed of three primary components; 30A fused disconnect, extension shaft, NEMA 4X operating handle. Square D 9421 NC3 fused disconnect, 9421 NW2 disconnect handle and 9421 NS36 disconnect shaft or approved equal.

- E. Each filter shall be equipped with an adjustable water level sensor located in the influent chamber for the purpose of backwash initiation. The high level sensor shall be a height adjustable PVC encapsulated 316 SS Rod with a diameter of 5/16" and length of 12", and shall include a PVC encapsulated copper conductor with control wire connected at top of probe. The installing Contractor is to provide wiring and conduit to connect the level sensor to a liquid level relay located in the Discfilter Control Panel. The liquid level relay is activated when the level sensor comes in contact with water in the influent chamber. The liquid level relay for backwash shall be SSAC LLC44A5A with relay base or approved equal.
- F. Each filter unit will be supplied with a high high level sensor. The device used for the high high level sensor will be the same part(s) and number used for the high level sensor. The high high level sensor will be mounted in such a way as to insure that the device indicates when the water reaches a height above the backwash level sensor and has entered a high level scenario. When the high high level sensor is activated, it will activate a relay inside the control cabinet and a pilot light on the front of the control panel will illuminate. The pilot light will be labeled "Discfilter High High Level". The high high level relay will have a spare set of normally open dry contacts available for monitoring. The liquid level relay shall be SSAC LLC44A5A with relay base or approved equal.
- G. Each filter unit will be supplied with a BW pump dry run protection pressure switch. The BW pump dry run protection sensor shall be a Nautilus XMLA fixed differential single threshold pressure switch. The sensor will be mounted in the piping downstream of the backwash pump. When the sensor is activated by low pressure, it will activate a relay inside the control cabinet to prevent running the pump.
- H. Field wiring terminal blocks for the Discfilter Control Panel will be din rail mountable, individually numbered, rated for 600 Volts 30 Amps. The field wiring terminal blocks shall be Phoenix UTTB4 3044814 or approved equal.
- I. Motor wiring terminal blocks for the Discfilter Control Panel will be din rail mountable, individually numbered, rated for 600 Volts 65 Amps. The field wiring terminal blocks shall be Phoenix UT10 3044160 or approved equal.
- J. A motor starter located in the Discfilter Control Panel will manage the start/stop of the Backwash Pump motor. The motor starter will be sized appropriately to match the requirements of the Backwash Pump motor. The motor starter will be an IEC starter, rated 0.1 ~ 25Amps @ 460VAC 3 phase, ½ ~ 20HP @ 460VAC 3 phase, rotary handle operator, visible trip indication, protection by overload, short circuit, undervoltage and shunt. The motor starter will be equipped with auxiliary contacts for monitoring and control. The IEC motor starter shall be Square D TeSys U or approved equal.
- K. A VFD located in the Discfilter Control Panel will manage the start/stop of the Filter Drum motor. The VFD will be sized appropriately to match the requirements of the Filter Drum motor. The VFD will be equipped with an integral keypad display for VFD interface and configuration, use sensorless flux vector technology, use with 3-phase asynchronous motors, monitoring and control inputs and outputs, motor and drive protection. The VFD will not require input/output filters or harmonic testing. The VFD will be hardwired for control and monitoring and will not

require any communication protocols such as Ethernet, DeviceNet, and Modbus. The VFD shall be Square D Altivar 320 or approved equal.

- L. The control panel shall have external pilot lights mounted on the door indicating run status of the filter unit and backwash pump. The pilot lights will be NEMA 4X, 120VAC, standard (no push to test) and 30mm. The pilot lights shall be Square D 9001 SKP1x31 or approved equal.
- M. The control panel shall have external selector switches (Hand-Off-Automatic). The selector switches will be NEMA 4X, 30mm, non-illuminated, manual return and equipped with contact blocks. The selector switches shall be Square D 9001 SKS43BH2 or approved equal. The control panel selector switches will allow the drum drive and backwash motor to be operated in Hand mode.
- N. The completed control panel shall be UL labeled per UL508A. The completed control panel will be factory tested and configured.
- O. The Programmable Controller will perform logic, timing, counting and real time clock operations. The Programmable Controller will be programmed using software to allow configuration of a downloadable program featuring input instructions, output instructions, timer instructions, counter instructions and counter instructions. The Programmable Controller will be equipped with a embedded 10/100 Base -T EtherNet/IP Port as well as USB programming port. The Programmable Controller will be equipped with a minimum fourteen 14 Digital Inputs (120VAC) and ten (10) Relay Outputs, additional I/O can be added via I/O expansion modules. The Controller shall be an Allen Bradley Micro850 2080-LC50-24AWB or approved equal.
- P. The Control System will be supplied with one Operator Interface. The Operator Interface will be capable of communicating with the Programmable Controller. The Operator Interface will be capable of displaying text and graphics, allow operator setpoint entry, and provide system status display. The Operator Interface will be a color touchscreen display, minimum four (4) inch diagonal, 10/100 Base-T Ethernet Port and mount to the panel front. The Operator Interface will be Allen Bradley 2711R-TxT or approved equal.
- Q. Control system will also allow for continuous back washing in HAND mode.
- R. The Contractor is responsible for providing Interconnecting wiring and/or conduit between the supplied control panel and Discfilter equipment. The Contractor shall provide any junction or pull boxes or any other like device needed to supply the interconnecting wiring.
- S. All field connections/terminations to the supplied control panels, the Discfilter equipment and between the Discfilter and supplied control panels shall be the responsibility of the Contractor.

2.10 COAGULATION/FLOCCULATION SYSTEM CONTROL PANEL

- A. The Coagulation/Flocculation System operation shall be managed by an automated control system. The automatic control will be focused around a Programmable Logic Controller (Allen Bradley Micro850) which will have hardwired I/O routed to the Coagulation/Flocculation PLC Control Panel.
- B. The Coagulation/Flocculation Control Panel shall be provided in a UL labeled, NEMA 4X 304 Stainless Steel enclosure. Each control panel shall consist of a control panel enclosure, fused main disconnect, control transformer, branch circuit breakers, IEC motor starter/protector, VFD,

hand-off-automatic switches, and liquid level sensor relay for initiating backwash. The power feed to the control panel shall be 480VAC 60Hz 3 phase control voltage shall be 120VAC 60 Hz 1 phase.

- C. The control panel enclosure shall meet the following criteria, 304 Stainless Steel, seams continuously welded and ground smooth, seamless foam-in-place gasket for watertight dust-tight seal, door opens 180°, quarter turn latches opened or closed using a screw driver, and NEMA Type 4X, UL Listed 4X. Saginaw SCE48EL3612SSLP or approved equal.
- D. The main disconnect shall be enclosed in the control panel, with a handle mechanism extending through the door. The main disconnect shall be a fused disconnect rated for 30 Amps 3-Pole. The main disconnect shall be composed of three primary components; 30A fused disconnect, extension shaft, NEMA 4X operating handle. Square D 9421 NC3 fused disconnect, 9421 NW2 disconnect handle and 9421 NS36 disconnect shaft or approved equal.
- E. Field wiring terminal blocks for the Coagulation/Flocculation Control Panel will be din rail mountable, individually numbered, rated for 600 Volts 30 Amps. The field wiring terminal blocks shall be Phoenix UTTB4 3044814 or approved equal.
- F. Motor wiring terminal blocks for the Coagulation/Flocculation Control Panel will be din rail mountable, individually numbered, rated for 600 Volts 65 Amps. The field wiring terminal blocks shall be Phoenix UT10 3044160 or approved equal.
- G. A motor starter located in the Coagulation/Flocculation Control Panel will manage the start/stop of the Coagulation Mixer. The motor starter will be sized appropriately to match the requirements of the Coagulation Mixer. The motor starter will be an IEC starter, rated 0.1 ~ 25Amps @ 460VAC 3 phase, ½ ~ 15HP @ 460VAC 3 phase, rotary handle operator, visible trip indication, protection by overload, short circuit, undervoltage and shunt. The motor starter will be equipped with auxiliary contacts for monitoring and control. The IEC motor starter shall be Square D TeSys U or approved equal.
- H. VFDs located in the Coagulation/Flocculation Control Panel will manage the start/stop of the Flocculation Mixers (one for each mixer required). The VFDs will be sized appropriately to match the requirements of the Flocculation Mixer. The VFD will be equipped with an integral keypad display for VFD interface and configuration, use sensorless flux vector technology, use with 3-phase asynchronous motors, monitoring and control inputs and outputs, motor and drive protection. The VFD will not require input/output filters or harmonic testing. The VFD will be hardwired for control and monitoring and will not require any communication protocols such as Ethernet, DeviceNet, and Modbus. The VFD shall be Square D Altivar 320 or approved equal.
- I. The Programmable Controller will perform logic, timing, counting and real time clock operations. The Programmable Controller will be programmed using software to allow configuration of a downloadable program featuring input instructions, output instructions, timer instructions, counter instructions and counter instructions. The Programmable Controller will be equipped with an embedded 10/100 Base –T EtherNet/IP Port as well as USB programming port. The Programmable Controller will be equipped with a minimum fourteen 14 Digital Inputs (120VAC) and ten (10) Relay Outputs, additional I/O can be added via I/O expansion modules. The Controller shall be an Allen Bradley Micro850 2080-LC50-24AWB or approved equal.
- J. The Control System will be supplied with one Operator Interface. The Operator Interface will be capable of communicating with the Programmable Controller. The Operator Interface will be

capable of displaying text and graphics, allow operator setpoint entry, and provide system status display. The Operator Interface will be a color touchscreen display, minimum six (6) inch diagonal, 10/100 Base-T Ethernet Port and mount to the panel front. The Operator Interface will be Allen Bradley 2711C-T6T or approved equal.

- K. The control panel shall have external pilot lights mounted on the door indicating run status of the mixers. The pilot lights will be NEMA 4X, 120VAC, standard (no push to test) and 30mm. The pilot lights shall be Square D 9001 SKP1x31 or approved equal.
- L. The control panel shall have external selector switches (Hand-Off-Automatic). The selector switches will be NEMA 4X, 30mm, non-illuminated, manual return and equipped with contact blocks. The selector switches shall be Square D 9001 SKS43BH2 or approved equal.
- M. The completed control panel shall be UL labeled per UL508A. The completed control panel will be factory tested and configured.
- N. Control system will also allow for continuous back washing in HAND mode.
- O. The Contractor is responsible for providing Interconnecting wiring and/or conduit between the supplied control panel and Coagulation/Flocculation equipment. The Contractor shall provide any junction or pull boxes or any other like device needed to supply the interconnecting wiring.
- P. All field connections/terminations to the supplied control panel and the Coagulation/Flocculation equipment shall be the responsibility of the Contractor.

3.00 EXECUTION

3.01 GENERAL

- A. Contractor shall install the Discfilter system per the Equipment Manufacturer's directions and the drawings. The Contractor will provide all supports and anchoring required to install the Discfilter unit. The plumbing/interconnecting piping, electrical connections, grating and handrails shall be provided by the Contractor as detailed on the drawings and specifications including winterization such as piping insulation or heat tracing/heat tape. The Equipment Manufacturer will provide adequate protection of the equipment for shipment to the project site. Installation instructions will be provided that specifically outline installation of the Discfilter. Lifting instructions will be provided to assist the Contractor.

3.02 FIELD SERVICES

- A. The Equipment Manufacturer shall furnish the services of a factory-trained representative based in the United States and employed by the manufacturer, for a minimum of four (4) working days and two (2) separate trips. These two trips shall consist of one (1) trip to monitor the installation and one (1) trip for start-up and instruction of plant operating personnel. The Contractor will provide to the Equipment Manufacturer a minimum prior notice of three (3) weeks in order to schedule these services.

4.00 WARRANTY

4.01 GENERAL

A. The Equipment shall materially conform to the description in this Specification and the Contract Documentation and shall be free from defects in material and workmanship. Warranty periods are 18 months from delivery or 1 year from beneficial use, whichever occurs first.

5.00 PERFORMANCE GUARANTEE

A. Process Guarantee

1. Basis of Design

a. Owner/Contractor hereby agrees to the Basis of Design as defined herein, confirms its accuracy and completeness, and agrees that it shall serve as the basis for the Process Guarantee.

b. Basis of Design

Notes:

1 – Assumed Values

2 – Peak TSS includes 15 mg/L solids generated from chemical addition and Average TSS includes 10 mg/L solids generated from chemical addition.

3 – Chemical co-precipitation may be required ahead of the secondary clarifiers to reduce phosphorus prior to the filters in order to meet the maximum allowable Total Phosphorus.

4 – Should influent characteristics fall outside stated limits; all Performance Requirements shall be deemed met. Average TSS concentrations are based on analysis of 24-hour composite samples.

Influent Characterization		
Parameter	Unit	Value
Influent Source	NA	Secondary Clarification following Activated Sludge
Peak Day Flow	MGD (gpm)	1.35 (938)
Peak Influent TSS	mg/L	35
Average Influent TSS	mg/L	20
Peak Influent TP	mg/L	1.5
Average Influent TP	mg/L	<1.0
Influent soluble non-reactive P	mg/L	≤ 0.02
Maximum Hydraulic Loading Rate	gpm/ ft ²	3.99

2. Further Conditions on the Basis of Design
 - a. In addition to the data provided in the Basis of Design, the following conditions shall apply:
 - 1) The water shall contain sufficient alkalinity, either present in the water or by means of chemical addition by the Owner/Contractor to provide sufficient alkalinity for proper coagulation and flocculation chemistry to occur.
 - 2) In the event that any of the influent characteristics fall outside the above limits during the Performance Test, the Performance Testing shall be delayed until influent characteristics return to the agreed upon limits defined in the Basis of Design unless the effluent requirements are being met. If the testing period is delayed, it shall restart from the point at which testing was interrupted once the influent characteristics fall within the Basis of Design limits. It shall not be necessary for the test sequence to restart from the beginning.
 - 3) Should the raw water characteristics not fall within the range specified above, Kruger and the Owner/Contractor can make mutually agreeable performance requirement adjustments, at any time during the testing period, to compensate for the influent raw water characteristics.
 - 4) If influent conditions do not fall within the above limits within twelve (12) months from Kruger's determination of system stability, the Performance Guarantee shall be deemed to have been met and Kruger shall have no further obligation or liability hereunder.
 - 5) The Owner/Contractor shall be responsible for providing influent within the limits and according to the Basis of Design conditions. If during the Performance Test any daily average is greater than those listed, Kruger reserves the right to use or exclude those results for the purpose of evaluation of the Process Guarantee. Should more than 50% of the influent data exceed the limits stated in the Basis of Design, the Owner/Contractor has the right, at their expense, to conduct additional testing.
 - 6) The wastewater does not contain any substance or element whose presence or concentration causes interference or inhibition, defined as: a substance that hinders the mechanisms of treatment; or whose treatment byproduct (sludge, dewatered liquor, etc.) is hazardous or otherwise requires additional cost for disposal; or may result in gases or vapors that pose a risk to system performance or human health; or that is corrosive, erosive, or abrasive; or which contains pollutants that obstruct the flow in the system. Examples include solvents, lubricants, preservatives,

quaternary ammonium compounds, fugitive polymers, oils, etc.

B. Process Guarantee Requirements

1. The Process Guarantee shall be defined by the table(s) in this section.
2. The Process Guarantee is predicated on all conditions specified herein, in the entirety of the Process Guarantee and Performance Test document.
3. The Process Guarantee shall be conclusively demonstrated through the successful completion of the Performance Test, as described herein.
4. Process Guarantee Table(s)

Process Guarantee Table – Effluent Requirements		
Parameter	Unit	Value
Monthly Average Effluent TSS	mg/L	≤ 5
Monthly Average Effluent TP	mg/L	≤ 0.10

Notes: Un-reactive phosphorus is broadly defined as phosphorus compounds (mostly polyphosphate) that do not respond to colorimetric tests without preliminary acid hydrolysis (or oxidative digestion) of the sample and can occur in both dissolved and colloidal forms. For purposes of quantitative measurement, the un-reactive phosphorus concentration is defined as the difference between the filtered Total Phosphorus and the filtered reactive phosphorus (ortho-phosphate) concentrations.

5.02 Performance Test

A. Timing of Performance Test

1. Start of the Performance Test
 - a. Kruger shall provide the Owner/Contractor written notice with the date when Kruger believes the process has reached system stability and is ready for the Performance Test to start in accordance with the requirements described herein.
 - b. Kruger’s determination with regard to system stability shall take into account factors that include, but are not necessarily limited to, the following:
 - 1) The system appears to be acclimated to the material (water, wastewater, biosolids, etc.) that it is intended to treat.
 - 2) The system’s unit operations appear to be functioning at acceptable operating conditions.
 - 3) The system is being operated with proper pre-treatment, pre-conditioning, or chemical conditioning as instructed by Kruger.

- c. The Owner/Contractor shall start the Performance Test within sixty (60) days after the date the process has achieved system stability as determined by Kruger.
- 2. Duration of the Performance Test
 - a. In the event that the Performance Test is interrupted due to equipment failure, at Kruger’s discretion, only the remaining unfinished test period will be tested following modifications/repairs to the system.
 - b. The Performance Test shall consist of five (5) 24-hour tests.
- 3. Performance Test Period Window
 - a. Should conditions meeting the Basis of Design not be available within twelve (12) months of Kruger’s determination of system stability, or the Owner/Contractor is otherwise unable to complete the Performance Test within the twelve (12) month period after Kruger’s determination of system stability, Kruger’s total liability with regard to the Process Guarantee shall be discharged. See requirements for Certificate of Performance Test Acceptance.

B. Sampling and Analytical Parameters

- 1. Owner/Contractor shall take and analyze samples for the purposes of determining system compliance with the Process Guarantee. Owner/Contractor shall bear all costs for sampling and analysis. The following are the minimum parameters for sampling and analysis:

Sampling and Analytical Parameters	
Parameter	Unit
Plant Flow, Influent/Effluent	MGD
TSS, Influent/Effluent, 24-hr Composites	mg/L
Total Phosphorus, Influent/Effluent, 24-hr Composites	mg/L
Soluble Total Phosphorus, Influent/Effluent, 24-hr Composites	mg/L
Total Reactive (Ortho) Phosphorus, Influent/Effluent, 24-hr Composites	mg/L
Polymer Dose	mg/L
Coagulant Dose	mg/L
Influent/Effluent pH	--

C. Sampling, Laboratory and Analytical Standards

AUTOMATIC BACKWASH DISCFILTER

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1. The Owner/Contractor shall use the publication, Standard Methods for Examination of Water and Wastewater, most recent edition; as the primary laboratory and analytical procedure source, unless otherwise agreed to by Kruger. All other analyses, data reduction or tests not specified in that publication or otherwise specified shall be carried out by the Owner/Contractor using procedures furnished or approved by Kruger.
2. In the case of continuous reading instrumentation, Owner/Contractor shall calibrate instrumentation at least once per test period. Calibration reports shall be available if requested by Kruger.
3. Owner/Contractor shall have all laboratory analyses performed at a state-certified laboratory where the project is located.
4. Kruger reserves the right to witness the sampling and testing and to take portions of the samples for analysis in its own laboratories.
5. The Owner/Contractor shall record influent and effluent water quality based on 24-hour composite samples collected each day of the performance testing period. Each 24-hour composite sampler shall be programmed to sample every hour at a minimum. Each 24-hour composite sample shall be analyzed according to the following parameters:
 - a. Owner/Contractor shall measure and record influent and effluent Total Suspended Solids (TSS) using instrumentation calibrated daily in accordance with EPA Standard Method 2540D or other commonly approved field test methods.
 - b. Owner/Contractor shall measure and record influent and effluent Total Phosphorus (TP), soluble TP, and Reactive (Ortho) P using instrumentation that they calibrate daily in accordance with EPA Standard Method 4500P or other commonly approved field test method by a certified lab with a ≤ 0.005 mg/L MDL at minimum for samples ≤ 0.10 mg-P/L.
 - c. The owner shall provide duplicate samples for each 24-hour composite sample for Kruger's use.
 - d. Total P Sampling and Analytical Procedure

Sampling	<ul style="list-style-type: none">● If effluent (Permeate) P concentrations are expected to be ≤ 0.10 mg P/L (in any form) sample bottles must be glass (acid rinsed with no preservative).● If P concentrations are expected to be > 0.10 mg P/L (in any form) plastic sample bottles are considered acceptable.● Do not use separate sample bottles for TP, dissolved P, ortho-P (if multiple bottles are used) when very low P concentrations are present, these bottles, in effect, can be considered multiple samples
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Sample storage	Stored immediately in cooler at 4 °C
MDL	If P concentrations are expected to be ≤ 0.10 mg P/L (in any form) MDL should be at least as low as 0.005 mg/L
PQL	For samples expected to be ≥ 0.01 mgP/L, the lab PQL should be equal to or less than 0.01 mgP/L. Any data reported below the laboratory PQL must be qualified
Interferences	<ul style="list-style-type: none">● Iron, the presence of iron can affect the results due to consumption of reducing agent (note: if SM4500PF is used, the interference from iron of up to 50 mgFe³⁺/L can be tolerated)● Nitrite● Arsenic (V)● Chromium (VI)● Turbidity● Color
Sample preservative	Sample bottles <u>must not contain acid preservative.</u>
Analytical Method	<p><u>Standard Method SM4500P E or F is the only acceptable method of analysis</u></p> <p><u>The following analysis must be completed on each composite sample</u></p> <ul style="list-style-type: none">● Unfiltered Samples: Total Phosphorus, Unreactive Phosphorus (ortho)● Filtered Samples: Total Phosphorus, Unreactive Phosphorus (ortho)<ul style="list-style-type: none">○ Filtration step must be completed in the laboratory using a 0.45 micron filter prior to addition of preservative or reagents.

D. Responsibilities During the Performance Test

1. Owner/Contractor

a. System Operations

- 1) Owner/Contractor shall be responsible for providing the influent conditions as specified in Basis of Design.
- 2) Owner/Contractor shall be responsible for furnishing all

personnel, influent, materials, utilities, services, chemicals, and all incidentals required for the operation of the complete facility, including Kruger's system.

- 3) Owner/ Contractor shall be responsible for operating Kruger's system in accordance with Kruger's O&M instructions, manuals and instructions, or Kruger's reasonable revisions of the same.
- 4) If required by Kruger, Owner/Contractor shall restore the system to the specified operating conditions before testing begins.
- 5) Should the Owner/Contractor operate the system outside of the specified operating conditions, the Process Guarantee shall be deemed to have been met, and Kruger shall have no further obligation or liability hereunder.
- 6) Should the Owner/Operator already have operated the system outside of the specified operating conditions, and such operation damaged system equipment, the Process Guarantee shall be deemed to have been met, and Kruger shall have no further obligation or liability hereunder.

b. Sampling and Analysis

- 1) Owner/Contractor shall be responsible and bear all costs for collecting all samples, carrying out all laboratory analysis or other tests, and furnishing all necessary labor, laboratory equipment, and supplies.
 - a) Owner/Contractor shall perform all sampling and analyses in accordance with Sampling, Laboratory and Analytical Standards defined elsewhere within this document.
- 2) Owner/Contractor shall provide all personnel and materials needed to capture and record influent and effluent water samples and to verify and record influent flow rates to the system.
- 3) A minimum of five (5) 24-hour composite samples (on both influent and effluent sources) will be taken over the course of the performance Test.

c. Record Keeping and Copies of Records

- 1) Owner/Contractor shall record and maintain such detailed records as may be necessary for determining whether the Process Guarantee has been met.
- 2) Owner/Contractor shall retain such records until the Process Guarantee has been satisfied or until the expiration of the Performance Test Period Window, whichever occurs earlier.
- 3) Owner/Operator's records shall include all daily log sheets, operator notes, sample inspections, calibration reports,

laboratory and analytical results, maintenance records, and instrument charts produced in operation of the plant.

- 4) Owner/Contractor shall provide one (1) copy of such records to Kruger at no charge upon Kruger's request.
- 5) Owner/Contractor shall make such records available to Kruger for inspection and for further copying at Kruger's expense.

d. Access to the System

- 1) Owner/Operator shall provide full access to Kruger's system, facility components upstream and downstream of the system that may impact system performance, and test results and records for Kruger's personnel or authorized subcontractor.

2. Kruger

- a. Kruger shall provide the Owner/Operator O&M instructions and manuals to advise the Owner/Operator, and reasonable revisions of the same, on system operation.
- b. Kruger shall have the right, but not the obligation, to:
 - 1) Inspect the system prior to testing to ensure the system meets Kruger's specified requirements for operation.
 - 2) Provide technical personnel on-site to provide technical input and to observe the Performance Test.
 - 3) Witness sampling and analysis, and to take its own samples to a lab of Kruger's choosing for analysis at Kruger's expense.
 - 4) Carry out adjustments to the system to optimize or improve the system's performance.
- c. Kruger shall consolidate the Performance Test data (data provided by Owner/Contractor) and provide the Owner/Contractor with the results in a Performance Test Report.

E. Determination of Performance Test Result

1. Performance shall be based on a comparison of the Basis of Design and the Process Guarantee Requirements. Measured values of the system performance shall be based upon:
 - a. Average of the measurements taken during the Performance Test. Time-weighted 24-hour composite samples shall be collected by the Owner/Contractor for each day of the Performance Test. Each composite sample shall be divided into a minimum of three aliquots and containerized as separate samples for analysis in accordance with Standard Methods for the Examination of Water and Wastewater, latest edition.
2. Upon receipt of test data confirming that the Process Guarantee has been met, the Performance Test shall have been deemed successful and Kruger's total liability

under the Process Guarantee shall be discharged and the Owner/Contractor shall have no further recourse against Kruger or any claims for recovery with respect to the Process Guarantee.

3. Kruger shall then execute and submit the Performance Test Report and the Certificate of Performance Test Acceptance.
4. Owner/Contractor shall execute the Certificate of Performance Test Acceptance as specified elsewhere herein.
5. If Owner/Contractor does not return the executed Certificate of Performance Test Acceptance within fourteen (14) calendar days, the Certificate shall be deemed to have been issued with the effective date being the date the Performance Test was completed.

F. Remedies in Event of Performance Test Failure

1. If, during the Performance Test, it appears that the Process Guarantee is not being met:
 - a. Kruger shall have the right to have the system operated at such conditions as it may deem necessary or advisable for purposes of determining the nature or cause of the failure of the system to meet such guarantee, provided such operating conditions are in accordance with good engineering practices, Owner/Contractor's regulatory obligations, safety rules, operational restraints, and similar requirements.
 - 1) Kruger shall have the right to decide if the performance test shall continue or be restarted.
 - 2) If at any time during the performance testing period the process does not meet the performance standards, only the out-of-compliance testing period will be repeated.
 - b. If the performance testing is interrupted by factors out of Kruger's control and/or scope of supply, only the uncompleted portion of that testing period shall be required to be completed for compliance with the testing period requirements.
 - c. Kruger shall have the right to make or have made such adjustments as it deems necessary or advisable in order to meet such guarantee and to make or have made, at its own expense, such alterations or modifications to the Kruger system as it deems necessary or advisable. It is understood and agreed that any mechanical corrective work necessary to cause the system to meet the Process Guarantee shall be performed by Kruger, a Kruger-authorized subcontractor, or the Owner/Contractor as agreed upon by Kruger. Corrective work shall be allowed to commence as soon as practical.
 - d. Kruger shall have the right to conduct two (2) additional Performance Tests to meet the Process Guarantee at Kruger's expense. Prior to the start of any of these subsequent tests, Kruger shall have the right to make any additional modifications to the system at Kruger's expense.

- e. In the event that the system fails to meet the Process Guarantee, Kruger's sole obligation and Owner/Contractor's sole remedy shall be to replace or modify the system as Kruger deems appropriate to enable the system to meet such Guarantee, subject to the following:
 - 1) Kruger shall not be accountable for failure to meet the Process Guarantee during this necessary modification period.
 - 2) The Owner/Contractor shall allow for sufficient time for the order and delivery of any necessary equipment for Kruger to complete modifications to the system.
- f. Notwithstanding anything else to the contrary, Kruger shall not be liable for any consequential, incidental, special, punitive or other indirect damages, and Kruger's total liability arising at any time from the sale or use of the equipment shall not exceed the purchase price paid for the equipment. These limitations apply whether the liability is based on contract, tort, strict liability or any other theory.
- g. There are no guarantees established, express, implied or statutory, except those set forth herein. In no event, be it due to a breach of any guarantee herein or any other cause, shall Kruger be liable for or obligated in any manner to pay consequential, special, punitive, or indirect damages, including, but not limited to, loss of profits, system downtime, fines or penalties, or suits by third parties against the Owner/Contractor.

G. Mechanisms that Discharge the Process Guarantee

- 1. Upon any of the following, Kruger's total liability for the Process Guarantee shall be discharged:
 - a. Successful completion of a Performance Test, as demonstrated by the Performance Test results.
 - b. Owner/Contractor's operation of the system at any time (prior to or during the Performance Test) outside of the operating conditions as specified herein in a manner that does damage to the system's equipment.
 - c. Owner/Contractor's operation of the system during the Performance Test outside of the operating conditions as specified herein.
 - d. Conditions meeting the Basis of Design are not available within twelve (12) months of Kruger's determination of system stability, or the Owner/Contractor is otherwise unable to complete the Performance Test within the twelve (12) month period after Kruger's determination of system stability.
 - e. Any other conditions outside of Kruger's control, including but not limited to the following:
 - 1) Noncompliance with the Basis of Design as specified herein.
 - 2) Engineering design (other than that by Kruger).

- 3) Materials and equipment (other than those specified or supplied by Kruger).
- 4) Workmanship and services (other than those provided by Kruger).
- 5) Defective materials or mechanical conditions, or deficient performance of equipment or auxiliary parts (other than those supplied by Kruger).
- 6) Defective conditions or performance of any materials, equipment (other than equipment supplied by Kruger) or work supplied by or contracted for by anyone other than Kruger.
- 7) Failure of the Contractor to furnish adequate utilities, such as, but not limited to, electricity, air, water, etc. as set forth in the O&M Manual and /or O&M training supplied by Kruger, or Kruger's reasonable revisions of the same.
- 8) Failure of the Owner/Contractor to provide adequate personnel.
- 9) Mechanical failure of any of the equipment or component parts thereof due to ordinary wear and tear or any other cause.
- 10) Failure of the Owner/Contractor to perform any of the responsibilities and obligations specified herein.
- 11) Any other cause outside of a cause attributable to Kruger, including Force Majeure.

H. Certificate of Performance Test Acceptance

1. A Certificate of Performance Test Acceptance shall be executed by both parties upon discharge of the Performance Guarantee:
 - a. Upon successful completion of the Performance Test, Kruger shall execute and submit the Performance Test Report and Certificate of Performance Test Acceptance to the Owner/Contractor. Owner/Contractor shall execute the Certificate of Performance Test Acceptance effective as of the date the Performance Test was completed, and return the Certificate to Kruger within fourteen (14) calendar days of its receipt from Kruger. If Owner/Contractor fails to execute the Certificate of Performance Test Acceptance within the fourteen (14) calendar days, the Certificate shall be deemed to have been issued with the effective date being the date the Performance Test was completed.
 - b. Should conditions meeting the Basis of Design not be available within twelve (12) months of Kruger's determination of system stability, or the Owner/Contractor is otherwise unable to complete the Performance Test within the twelve (12) month period after Kruger's determination of system stability, the Certificate shall be deemed to have been issued with the effective date being the date the Owner/Contractor notifies Kruger that the Owner/Contractor is unable to complete the Performance Test within the specified period, or the date twelve (12) months after Kruger's

AUTOMATIC BACKWASH DISCFILTER

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determination of system stability, whichever comes first.

- c. Should the Performance Test and/or Process Guarantee be discharged for any of the other reasons as specified herein, the Certificate shall be deemed to have been issued with the effective date being the date that Kruger determines the Process Guarantee is discharged.

CERTIFICATE OF PERFORMANCE TEST ACCEPTANCE

The undersigned representative of Kruger hereby certifies that the Kruger System successfully completed the Performance Test on _____ and as required by the Contract between Kruger and _____ for the named project.

Kruger System: _____ Discfilter Filtration System _____

Project Name: _____

Veolia Water Technologies, Inc. dba Kruger

Signed: _____

Printed or Typed Name: _____

Title: _____

Date: _____

ACCEPTANCE:

Owner/Contractor hereby agrees that the Kruger system has successfully completed the Performance Test and the Process Guarantee is discharged as of the completion date shown.

Owner/Contractor

Signed: _____

Printed or Typed Name: _____

Title: _____

Date: _____

****END OF SECTION****

1.00 GENERAL

1.01 DESCRIPTION:

- A. The work specified in this Section includes the furnishing, installation and commissioning of a complete closed vessel, medium pressure, high intensity, ultraviolet (UV) disinfection system as described herein and as shown on the Drawings. The disinfection system and all associated equipment, controls, and appurtenances shall be selected and designed by the manufacturer for this installation and as needed for a complete and fully operational disinfection system capable of disinfecting municipal wastewater. Disinfection system shall include closed vessel, medium pressure, high intensity, UV disinfection chambers, low flow recirculation pumping system, automatic actuator valves, and all associated instrumentation, electrical panel(s), and control panel(s). All equipment and appurtenances shall be provided by a single manufacturer. Layout of the equipment shall be as shown on the drawings. All equipment, parts, appurtenances, mechanical connections, electrical connections and any other item(s) and/or work shown or not shown on the drawings and/or specifications which is required for a complete and operational ultraviolet disinfection system shall be included in the amount bid. Work shall include manufacturer design/sizing/selection of the system, equipment/materials, delivery, installation, installation assistance, inspection, certification of installation, functional testing, startup and job site training.
- B. Special provisions, requirements and/or revisions to this Specification and/or Bid Item(s) may be included in Section 01010 (green pages) and/or on the Drawings or Details.
- C. Electrical and control components shall be in conformance with Dive 26 of these contract documents.
- D. The Contractor shall guarantee that the system shall be capable of disinfecting a flow of 1,960 gpm with the water characteristics as defined in section 2.02 Operating Parameters.

1.02 SUBMITTALS:

Submittals shall conform to Section 01 33 00 of these Specifications and shall include the following:

- A. Layout, overall dimensions, required clearances and general description of the equipment, including location of electrical equipment, control panels and other auxiliary equipment.
 - 1. Certified general arrangement drawings showing all details including materials of construction, dimensions, loads on supporting structures, and anchor bolt locations. Arrangement shall show as-built dimensions (see as-built requirements herein).
 - 2. Complete manufacturers information and details on all equipment to be used. Shall include descriptive literature, bulletins and/or catalogs of the equipment.
 - 3. Piping shop drawing with dimesons, clear space, etc and flow schematic
 - 4. Details of attaching equipment, services, auxiliary equipment, accessories, etc.
 - 5. Electrical control schematics, wiring diagrams and general description including list of materials.
 - 6. Operating characteristics of all electrical and control equipment: operating voltage and amperage tolerances: ancillary electrical services required.

7. List of which components and materials shall be shipped preassembled and parts list for the other components and materials. Weights and physical dimension shall be indicated for each part, assembly, and/or package to be shipped.
8. Provide Operation and Maintenance data for incorporation in the O&M manuals as specified. Include complete description of operation together with general arrangement and detailed drawings: wiring diagrams for power and control schematics, parts catalogs with a complete list of repair and replacement parts with section drawings illustrating the connections and identifying numbers. Wherever possible, provide information on electronic media, using AutoCad R14 drawings and PDF for documents, in addition to hard copies.

1.03 ACCEPTABLE MANUFACTURER AND MODEL / QUALITY ASSURANCE:

A. Acceptable manufacturer is Evoqua Water Technologies, or approved equal. Approval of an alternate shall follow process outlined in Article 11 of the Instructions to Bidders.

B. Closed Vessel UV Disinfection Manufacturer Qualifications:

1. Closed vessel UV disinfection manufacturer must have at least 10 years of experience in the United States in the design, application, and supply of disinfection systems.
2. All qualifying installations and references must be for disinfection of municipal wastewater at municipal wastewater treatment plants.
3. Closed vessel UV disinfection manufacturer must have a repair facility in North America that has the necessary equipment to rebuild UV chambers and stocks UV chamber spare parts.
4. An officer of the Company is required to certify the proposed alternate manufacturer has completely read the specification and takes no exception; or if exceptions are taken they must be listed in the alternate equipment proposal in accordance with Section 01 25 00.

D. Workmanship and Design:

1. All parts of the equipment provided to be designed and manufactured for long, continuous and uninterrupted service. All materials to be used are of best quality and entirely suitable for service required.
2. Provisions to be made for easy maintenance, adjustment or replacement of all serviceable parts.
3. UV chamber assembly shall be designed to assure easy disassembly of the unit, including removal of the UV bulbs from the chamber, within the space provided.
4. The corresponding parts of multiple units if applicable shall be interchangeable.

1.04 WARRANTY:

The Manufacturer shall furnish a written warranty that provides for:

- A. Warranty of full replacement of components for the closed vessel UV disinfection system and all associated equipment and appurtenances against defects in materials and workmanship shall extend for 12 months after start-up.

- B. Warranty shall include all parts, labor, shipping, and coatings for repairing or replacing equipment that fails during the warranty period. Defects occurring within the warranty period shall be repaired or replaced by the manufacturer at no cost to the Owner.
- C. Full replacement of all defective lamps within the first 2,000 hours of operation provided that the system is operated continuously.

1.05 PRECONSTRUCTION AS-BUILT

Prior to construction Contractor shall obtain and provide to the manufacturer as-built information required for manufacturer design/selection/supply of the equipment and appurtenances specified herein to be installed at the location shown on the Drawings. Equipment shall be manufactured to accommodate existing conditions and for installation as shown, and shall include all required appurtenances, anchors, connections, and any other needed item for a complete and operational system sized for this specific installation and installed at the location shown in the Drawings. Any modifications required to existing structures, building, or other existing features shall be included in the amount bid.

1.06 DELIVERY, STORAGE AND HANDLING:

Items to be shipped as complete assemblies except where partial disassembly is required by transportation regulations or for protection of components. Equipment shall be delivered as completely assembled as practical to minimize field assembly. Contractor shall be responsible for unloading and any necessary field assembly. Contractor shall contact manufacturer for assembly requirements during bid.

1.07 TEMPORARY UV DISINFECTION / SEQUENCING AND SCHEDULING:

Coordinate work with restrictions as specified in the Contract Documents. UV disinfection system sequencing will require temporary UV disinfection while the improvements herein are constructed. Temporary UV disinfection is the sole responsibility of the Contractor including configuration, piping, installation, operation, and disassembly. Temporary disinfection may utilize the new equipment. Temporary disinfection configuration shall be designed and proposed by the Contractor to the Owner during the submittal period for Owner review. Owner revisions to the system and/or requirements are considered incidental and shall be included in the amount bid. See also Section 01 01 00 Special Requirements and Section 01 89 00 Sequence and Limitations of Construction.

2.00 PRODUCTS

2.01 GENERAL:

The Contractor shall furnish and install a complete medium pressure, high intensity UV disinfection system, including a low flow recirculation pump, as described herein. The system shall include, but is not limited to, a stainless steel disinfection chamber, recirculation pump/system, automatic actuator valves, and associated power and control equipment. The Contractor shall be responsible for furnishing and installing equipment per the project specifications and drawings, start-up, testing, and operation and maintenance training of the Owner's personnel.

2.02 OPERATING PARAMETERS:

The UV disinfection units shall be used to disinfect wastewater which has undergone secondary or tertiary treatment. The system shall be designed for the following water quality and flow conditions.

- Maximum Flowrate: 1,960 gpm
- Average Flowrate: 354 gpm

- Minimum Flowrate: 22 gpm (recirculation pump to operate for flows lower than 50 gpm—see requirements herein)
- Transmittance: >65 % in a 1 cm quartz cell @ 253.7 nm
- Total Suspended Solids: <30 mg/l
- Influent Fecal Coliform/E. Coli Count: <63,000 fc/100 ml
- Effluent Fecal Coliform/E. Coli Count: <200 fc/100 ml
- Maximum Allowable Head Loss: <8.5 in (@ maximum flowrate)

The system supplied shall be arranged in the following manner:

- Number of Lamps in each UV chamber: 6
- Number of UV Chambers: 2

2.03 ULTRAVIOLET DISINFECTION CHAMBER:

A. Chamber

1. The UV system shall consist of 2 UV chamber(s). The chamber(s) shall be capable of disinfecting up to 1,960 gpm of wastewater of characteristics described in section 2.02 Operating Parameters. Maximum design flowrate per chamber shall be 980 gpm. Open channel systems or closed vessel systems using low pressure, low pressure high output, or low pressure amalgam lamps will not be acceptable.
2. Each chamber shall have isolation valves (furnished and installed by Contractor) installed upstream and downstream of the UV system allowing flow isolation during times of maintenance.
3. The chamber(s) shall be constructed of 316L SS. All wetted parts shall be stainless steel, high purity quartz, Viton, or other UV resistant material. UV chambers not manufactured of 316L SS will not be acceptable.
4. Lamps shall be protected from contact with the water by high purity quartz sleeves/thimbles. The lamps shall be removed from the motor side of the chamber.
5. The chamber(s) shall be designed in such a way that when properly installed and operated there is no possibility of direct operator exposure to UV light from the UV lamps.

B. UV Lamps

1. Only medium pressure high intensity ultraviolet lamps shall be provided for disinfection. Maximum power consumption for each UV chamber shall be 27kW. Maximum power consumption includes lamp power, power supply losses, cooling fans, and all other appurtenances.
2. The power/control operation shall allow for multiple lamp power levels to extend their operating life. Output of lamps shall vary from 50 to 100% and shall automatically adjust based on lamp intensity, flowrate, and/or UV transmittance.
3. Lamps shall be single ended frame style. Lamps that require connections on both sides of the chamber will not be acceptable.
4. Germicidal UV output from the lamps shall not be affected by temperature.

5. The lamp connections shall be quick disconnect type and have a fail-safe mechanical interlock to prevent lamp removal without disconnecting power. If the lamp is disconnected when live the design should be such that operators are protected from the live terminals.
6. Lamp design shall be a water tight design NEMA4 (IP68).

C. UV Intensity Monitor

1. One lamp in each chamber shall be equipped with a UV monitor, which measures the UV intensity of that lamp, providing continuous performance verification.
2. The monitor shall be fitted with a filter, which allows measurement of UV energy between 220 and 290 nm wavelengths.
3. The monitor shall be unaffected by static, electromagnetic fields, or short wave radio emissions that comply with current FCC regulations.
4. The monitor shall manipulate a 4-20mA signal and return it to the power/control module.
5. The monitor shall have an IP67 rating and shall be removable without draining the chamber (dry connection).

D. Cleaning Mechanism

1. For periodic cleaning of the quartz sleeves/thimbles and UV monitor probe, the chamber shall be fitted with an automatic/mechanical cleaning mechanism, consisting of a SS yoke and molded Viton wiper rings which fit over the quartz sleeves/thimbles. Wiper rings shall be replaceable. Wiper rings manufactured of steel will not be acceptable.
2. The cleaning mechanism shall be electrical/mechanical and shall be operated by means of a 24V DC fractional horsepower motor and a lead screw. Pneumatic or hydraulic cleaning mechanisms or motors that require voltages greater than 24 V will not be acceptable.
3. The cleaning mechanism shall operate by pulse technology which will stop the wiping mechanism before it reaches the end of the chamber. No limit switches (external or internal) shall be used to monitor the position of the wiper mechanism. Wiping mechanisms that require use of limit switches will not be acceptable.
4. The cleaning cycle shall be field adjustable.

E. Temperature Sensor

A temperature sensor shall be fitted to the chamber for protection against heat buildup under low or no flow conditions. The UV system shall shut down and alarm in event of heat buildup in the chamber.

F. Access Hatch

A circular access hatch shall be provided on top of the chamber to allow easy, simple access for visual lamp and/or sleeve/thimble inspection and/or removal of foreign debris from the chamber without removing the lamps or quartz sleeves/thimbles. The profile of the hatch shall be designed to eliminate flow disruptions and air pockets.

2.04 LOW FLOW RECIRCULATION PUMP:

A. General

A low flow recirculation pump system shall be designed, furnished, and installed by the Contractor which pumps effluent from the discharge side of the UV reactors to the influent side to provide adequate cooling to the UV units in accordance with the manufacturers recommendations. See Drawings for example layout. The low flow recirculation pump shall turn on when flows passing through a single chamber are less than or equal to 50gpm, as recorded by the effluent parshall flume. The metering pump will be called off once flow passing through the effluent parshall flume exceeds 50gpm for more than 5 minutes.

B. Power Requirements

1. HP shall be selected by the manufacturer as needed for adequate recirculation pumping to the UV reactors. The recirculation pump shall be a minimum 0.5Hp motor.
2. 480V 3-phase, 60Hz

2.05 AUTOMATIC ACTUATOR VALVES:

A. General

Contractor shall select, furnish, and install automatic actuator valves capable of directing flow in response to flow conditions passing through the parshall flume and Owner determined alternating sequence. See Drawings for location of automatic actuator valves. Actuator valves shall be as recommended by the UV Disinfection System manufacturer for this specific installation.

B. Controls Requirements

The control system shall operate the automatic actuator valves as necessary for the two UV disinfection chambers are to alternate between lead and lag in order to balance operating hours between the two chambers and to provide parallel operation under high flows. The automatic actuator valve associated with the lead UV disinfection chamber is to remain open. The automatic actuator valve associated with the lag UV disinfection chamber shall open when flow exceeds the treatment capacity of a single UV disinfection chamber in accordance with the manufacturer's recommendations. As flows decrease within the treatment capacity of a single UV disinfection chamber, the automatic actuator valve associated with the lag UV disinfection chamber shall close. Lead and lag actuator valve and reactor shall alternate on an owner selectable schedule.

2.06 ELECTRICAL/INSTRUMENTATION AND CONTROLS:

A. General

1. The quantity and size of power/control cabinet(s) are designated on the drawings.
2. Cabinet(s) shall conform to NEMA12, suitable for indoor installation in an environmentally controlled room (32 to 113 deg F and 15 to 90% relative humidity).
3. Cabinet(s) shall be fan cooled with louver covers and replaceable filters.
4. Cabinet(s) shall be constructed of epoxy coated steel.

5. The door shall be electrically interlocked so that it is de-energized when opened.
6. All wiring within the cabinets shall be harnessed or enclosed in wire channel.
7. Incoming circuits shall be protected by circuit breakers.

B. Power Requirements

1. 480V 3-phase, 3 wire, 60 Hz

C. Power/Control Cabinets

1. Each of the cabinet(s) shall power and control the required number of lamps to treat the water as specified in Section 2.02 Operating Parameters.
2. The power/control cabinet(s) shall contain a 7” resistive touch HMI for operator interface mounted at eye level. The incorporation of a resistive touch HMI interface, allows the system to be controlled without having to remove gloves. Systems that utilize a capacitive touch HMI, LEDs, or membrane buttons will not be acceptable.
3. All information, warnings, and alarms shall be presented on the HMI for ease of operation and fault finding. The HMI shall display a minimum of the following:
 - (a) UV dose
 - (b) UV intensity (% and mw/cm²)
 - (c) Lamp current
 - (d) Flowrate
 - (e) Chamber temperature
 - (f) Operation hour meter
 - (g) Lamp fault
 - (h) Low UV alarm
 - (i) High temperature alarm
 - (j) Ground fault trip
 - (k) Wiper fault

2.07 MONITORING/INTERFACING AND CONTROL REQUIREMENTS:

The control module shall contain the following system interface controls:

- A. Local/Remote operation
- B. Process interrupt (from valves and/or flowmeter)
- C. Low UV dose (configurable to shutdown or alarm only)
- D. Flowmeter input
- E. Online transmittance monitor input
- F. Automatic restart
- G. Half to full power UV setting
- H. Variable power control
- I. Dose pacing interface
- J. Monitor through Internet
- K. Interface with SCADA through MODBUS or available hardwire IO

2.08 QUALITY RECORDS:

The controls shall have a built in data logging capability (retrievable through a PC or laptop) that shall log the following parameters:

- A. UV dose
- B. UV intensity measured
- C. Lamp current
- D. Chamber temperature
- E. Flowrate
- F. Time and date stamp
- G. All alarms generated
- H. System power level

2.09 SPARE PARTS:

The following spare parts shall be supplied with the equipment:

- 12 UV lamps
- 12 Quartz thimbles
- 12 Sets of quartz thimble seals
- 12 Wiper rings

2.10 MANUFACTURER ON-SITE SERVICES:

A Manufacturer's representative shall as a minimum perform the following tasks during start-up/commissioning:

- A. Inspect, test and adjust the equipment after installation to verify mechanical, structural and electrical integrity and conformance to the equipment specifications. This task shall be scheduled for 2 trip(s) requiring a maximum of 5 day(s) on site.
- B. Instruct Owner's personnel in the proper operation and maintenance of the equipment.
- C. Provide additional services at no cost to the owner to correct any operational problems due to the design and/or fabrication of the UV equipment. Any problems with the UV associated with upstream process failures or incorrect use of the equipment will not be covered under this section.

3.00 EXECUTION

3.01 PREPARATION

- A. The existing UV building shall be prepared for installation of the equipment in accordance with the Contract Documents and with manufacturers recommendations and as needed for installation and for a fully operation system.
- B. Contractor shall verify all dimension in the field to ensure compliance of equipment dimensions with the drawings. See as-built requirements in section 1.00 of this specification

3.02 FABRICATION:

The UV disinfection system specified herein should be factory assembled, to the largest extent possible, complete with all components specified.

3.03 INSTALLATION:

- A. The Contractor shall install the UV equipment based upon the project plans and specifications and Manufacturer's submittal.
- B. The Manufacturer shall answer any additional related questions that the Contractor may have.

3.04 DELIVERY OF EQUIPMENT:

- A. Contractor shall coordinate work herein with construction sequencing and phasing requirements included in the Contract Documents. See temporary UV disinfection requirements herein.
- B. Equipment supplied under this section shall not to be delivered to the site until construction has progressed to the point where installation may properly commence.
- C. All equipment shall be protected and shall be in accordance with the Manufacturer's recommendations.
- C. Contractor shall replace any equipment damaged after receipt of equipment at no cost to the Owner.

3.01 INSTALLATION:

- A. Installation shall be in strict accordance with the Manufacturer's recommendations and instructions and shall be in accordance with the specifications herein and the Drawings. Installation shall include all equipment, labor, materials, connections, or any other item needed for a complete and operational perforated plate filter screen.
- B. All equipment, components, piping and appurtenances shall be installed true to alignment and rigidly supported. Any damage caused by the negligence of the Contractor to the above items shall be repaired or replaced by the Contractor to its original condition.
- C. Manufacturer's representative to inspect the installation prior to startup in order to verify that the equipment has been properly installed.
- F. Manufacturer's representative shall calibrate the equipment with the Owner's operator present after installation prior to startup.
- G. All products, accessories, and appurtenances shall be installed in accordance with manufacturer's instructions and approved submittals.
- H. The Contractor shall provide all hardware and accessories required for installation.
- I. Anchor bolts and all needed connectors are to be sized by Manufacturer and provided by Contractor.
- J. Temporary UV disinfection shall be installed and operated by the Contractor for the duration of construction of the UV disinfection improvements, and until the new UV disinfection system (specified herein) is fully operational and in service.

3.05 TESTING:

- A. Prior to startup, the Manufacturer shall inspect the installed UV disinfection system for proper alignment, correct operation, proper connections, and satisfactory function of all components. This inspection will occur during start-up/commissioning visit.

- B. After startup and as part of the equipment certification process, the Contractor shall submit to the Manufacturer one month of collected data as indicated below. This information will be used by the Manufacturer to provide feedback to the systems operation.
1. Monthly operator's reports for 30 days following start-up.
 2. Daily values for:
 - a. Plant flow (at time sample was collected)
 - b. Number of units in operation
 - c. Power level
 - d. Lamp intensity and/or dose
 - e. Time sample was collected
 - f. Fecal/E. coli count/100 ml (influent and effluent)
 - g. Transmittance
 - h. Effluent Iron Concentration (mg/L)
 - i. TSS
 - j. Sample collected by
- C. All laboratory tests necessary to confirm the Guaranteed Performance Requirements testing for the UV Disinfection System shall be performed by Contractor in accordance with the applicable portions of the most recent edition of Standard Methods.

4.00 MEASUREMENT AND PAYMENT

4.01 GENERAL:

- A. See Section 01 22 00 – Measurement and Payment for General Requirements. See Section 01 01 00 – Special Requirements/Bid Items for possible modifications to Standard Bid Items.
- B. If no specific bid item is provided, measurement and payment shall be considered incidental and shall be included in the bid price for other items of work for the project.

4.02 BID ITEMS:

A. Ultraviolet Disinfection System

1. Included shall be designing, furnishing and installing the UV disinfection system including UV reactors, low flow recirculation pump system, temporary UV disinfection, automatic actuator valves, instrumentation, electrical, controls, and any and all other items required for a complete and operational UV disinfection system. Payment shall be limited to 80% until the equipment has passed all acceptance testing requirements and O&M manuals have been submitted and approved.
2. Payment shall be on a Lump Sum (L.S.) basis.

****END OF SECTION****

1.00 GENERAL

1.01 DESCRIPTION:

- A. The work included in this Section consist of designing, furnishing, and installing a frame mounted centrifuge dewatering system and appurtenances at the location shown on the Drawings. The dewatering system and all associated equipment, controls, and appurtenances shall be selected and designed by the manufacturer for this installation and as needed for a complete and fully operational dewatering system capable of dewatering municipal waste activated sludge including aerobically digested sludge. Dewatering system shall include dewatering centrifuge, frame with monorail system for removal of the drive assembly, polymer makedown system, sludge feed pump, and all associated electrical panel(s) and control panel(s). All equipment shall be provided by a single manufacturer. Layout of the equipment shall be as shown on the drawings. All equipment, parts, appurtenances, mechanical connections, electrical connections and any other item(s) and/or work shown or not shown on the drawings and/or specifications which is needed for a fully operational dewatering system integrated into treatment plant controls shall be included in the amount bid. Work shall include manufacturer design/sizing/selection of the system, delivery, installation assistance, inspection, certification of installation, functional testing, startup and job site training.
- B. Special provisions, requirements and/or revisions to this Specification and/or Bid Item(s) may be included in Section 01010 (green pages) and/or on the Drawings or Details.
- C. Electrical and control components shall be in conformance with Division 26 of these contract documents.
- D. All electrical equipment shall meet Class 1 Division 2 requirements.

1.02 REFERENCES:

- A. All work herein shall be in accordance with all pertinent codes and regulations and latest revisions thereof, including, but not necessarily limited to, the following:
 - 1. American Bearing Manufacturers Association (ABMA)
 - 2. American Gear Manufacturers Association (AGMA)
 - 3. American Society of Mechanical Engineers (ASME)
 - 4. American Society for Testing and Materials (ASTM)
 - 5. Institute of Electrical and Electronics Engineers, Inc. (IEEE)
 - 6. American Welding Society (AWS) and D1.1, Structural Welding Code.
 - 7. National Electric Code (NEC).
 - 8. National Electrical Manufacturers Association (NEMA).
 - 9. American National Standards Institute (ANSI).
 - 10. Conveyor Equipment Manufacturers Association (CEMA)
 - 11. Occupational Safety Health Administration (OSHA)

1.03 SYSTEM DESCRIPTION

- A. General:

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1. Decanter centrifuge dewatering system shall be a complete system capable of processing municipal waste activated sludge including aerobically digested sludge (see design and performance requirements). System shall include all components included herein and shown on the drawings, as well as any other items required for a complete and operational system whether shown, or not show, on the drawings. All work, labor, equipment, appurtenances, and any other item required for a complete and operational system shall be included in the amount bid.
2. Centrifuge shall be of high speed, horizontal, cylindrical-conical, solid bowl, counter-current, scroll type designed for continuous operation.
3. Centrifuge shall be capable of performing in accordance with the requirements set forth in these specifications. In order to be assured of meeting the required performance, the centrifuges shall be capable of operating at a max speed of 3400 rpm and a maximum operating G force of 3000 at the bowl wall. Speed control shall be provided by a solid-state variable frequency drive (frequency inverter).

B. Components and Appurtenances:

1. All equipment shall be furnished by the manufacturer of the sludge dewatering units; however, all equipment need not be manufactured by a single manufacturer.
2. Decanter centrifuge dewatering system with components as specified herein and shown on the Drawings as required for a complete and operation system, include but are not limited to, the following:
 - a. Centrifuge Assembly.
 - b. Main Drive Motor with variable frequency drive.
 - c. Hydraulic Back drive System.
 - d. Lubrication System.
 - e. Control Panel and Wiring.
 - f. Motor Starters and Appurtenant Enclosures.
 - g. Flexible Connectors, Dewatered Sludge, and centrate Chutes.
 - h. Spare Parts and special Tools.
 - i. Sludge feed pump sized/selected by the manufacturer.
 - j. Steel frame system designed by the manufacturer with mono rail for removal of the drive assembly.
 - k. Polymer feed system and appurtenances.
 - l. Shaftless conveyor and connection to existing conveyor system
 - m. Piping, plumbing, valves.
 - n. Electrical and control equipment, meters, etc.
 - o. Electrical and control panels.
 - p. Instrumentation and programing.
 - q. Wiring and conduits.
 - r. Any and all items required for a complete and operational decanter centrifuge dewatering system.

1.04 CONDITIONS OF SERVICE:

- A. Sludge dewatering equipment and appurtenances are to be installed as shown on the Drawings.

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- B. All equipment and appurtenances shall be suitable for exposure to splash and spill conditions, and 100% humidity.
- C. The equipment and its appurtenances shall be capable of receiving, conditioning and dewatering the feed sludge specified herein, and discharging the dewatered sludge into the sludge pumps, conveyors or gravity discharge chutes as the case may be. Each unit shall be capable of operating continuously and shall be suitable for dewatering the specified sludge continuously for up to 24 hours per day, 7 days per week.

1.05 PERFORMANCE CRITERIA:

Centrifuge system minimum performance requirements:

<u>Dewatering System Performance Requirements ⁽¹⁾</u>	
<u>Parameter</u>	<u>Value</u>
Number of installed centrifuges	1
Minimum internal bowl diameter, inches	18
Minimum bowl length (cylindrical portion), inches	70
Minimum Hydraulic capacity (not including polymer), gpm	50 – 100 gpm
Minimum Dry Solids Loading Capacity	1,485 lbs/hr
Anticipated Sludge Feed, % total solids (TS)	0.5 to 1.5%
Solids capture rate/recover	95%
Discharge Solids, % TS	16 – 25% with polymer additoin
Max polymer consumption	15 – 30 lbs/Dry Ton
Main Motor Minimum HP	40
Back Drive Motor Minimum HP	10
G-Force (f)	3,000
Type of Lubrication	Grease
Maximum Bowl Speed (RPM)	3,400
G-Force (g)	3,000

(1) Sludge type is municipal waste activated sludge (WAS) with total solids percent anticipated in the range of 0.5% - 1.5% (TS). Prior to bid, Contractor and centrifuge manufacturer shall conduct site visit(s) and preform any investigation(s) and task(s) needed to determine sludge characteristics, and as required to meet the performance requirements herein.

1.06 SUBMITTALS:

Submittals shall conform to Section 01 33 00 of these Specifications, and shall include complete manufacturer's literature, drawings, installation instructions, operation and maintenance manuals and written warranties for all pieces of equipment and accessories. Submittals shall include the following information:

A. Product Data:

1. Submit data completely describing product including plan and section views and listings of materials of construction.
2. Submit surface preparation and finishes to be applied to all equipment.
3. Shop drawings, catalog cut sheets, and other materials required to completely describe and specify the system and equipment. These shall include:
 - a. Dewatering system, feed pump, polymer system, solids conveyor, frame, and all components and appurtenances.
 - b. Complete manufacturer fabrication/assembly drawings stamped by a registered Engineer.
 - c. Certified shop drawings showing dimensions, weights, loading information and location of all components; Include details on interconnecting piping, supports, control panel and erection drawings, including complete motor data.
 - d. Foundations, installations, and grouting.
 - e. Services of manufacturer's representative.
 - f. Operating and maintenance instructions and parts lists.
 - g. Lubricants.
 - h. Special tools.
 - i. Bolts, anchor bolts, and nuts.
 - j. Sleeves and inserts.
 - k. Electric motors.
 - l. Voltage rating of motors.
 - m. Equipment drive guards.
 - n. Vibration isolators.
 - o. Nameplates.
 - p. Noise level data.

B. Detailed Shop Drawings shall include, but are not limited to:

1. Manufacturer detailed shop drawings stamped by a registered Engineer.
2. Certified drawings showing dimensions, weights, loading information and location of all components; Include details on interconnecting piping, supports, and control panel.
3. Wiring, control schematics, and control logic diagrams for all electrical and control components furnished.
4. Manufacturer's Drawings shall be coordinated with the Contract Drawings, including equipment numbers and piping designations.
5. Detailed drawings and specifications of all items of equipment showing all pertinent dimensions, parts, and construction details and materials, and installation details and requirements. This shall include as-built dimensions obtained by the Contractor showing installation and clear space based on actual equipment to be installed within the existing building.
6. Performance specifications of all items of equipment.
7. Instrument layout of control panels.
8. Complete instrumentation and control and wiring diagrams in sufficient detail to allow installation of instrumentation and controls, and electrical components. Specifically, the following required:
 - a. Complete instrumentation and control schematics.

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- b. Complete electrical circuit schematics, including all motor control, alarms, and power to motors and accessories such as analytical instruments, etc. Schematics include termination points in various panels. Every circuit assigned circuitry number; every wire assigned wire number. In schematics, wiring is identified by numbers. Also, in schematics, every termination point assigned number, and number or identifier assigned to each terminal strip. Both terminal point number (including wire number) and terminal strip identifier appear on the schematics for each wiring termination shown.
 - c. Complete electrical instrumentation and control schematics of control panels and field junction boxes. (Note these are to be supplied prewired.) Schematics to provide complete information on terminal strips and panel instruments.
9. Manufacturer's Drawings shall be coordinated with the Contract Drawings, including equipment numbers and piping designations.
- C. Structural Calculations:
- 1. Structural anchor points to concrete foundation.
 - 2. Seismic loads on frame and anchor bolts.
 - 3. Structural design calculations for design frame system including drive assembly removal system
- D. Resume of Technician to perform system adjustments, inspections, observations of test operations, supervision of functional and performance testing, and training.
- E. Training Course Outline
- F. List of Recommended Spare Parts with price information
- G. Operating and Maintenance Manuals: Include complete lubrication, maintenance, and operation instructions, including initial start-up instructions, and unloading and handling methods.
- H. Manufacturer's references
- I. Quality Control Submittals:
- 1. Special shipping storage, protection, and handling instructions
 - 2. Manufacturer's Installation Instructions
 - 3. Factory Test Results including Certified shop testing results as set forth under "Quality Assurance." And certified acceptance test results.
- 1.07 ACCEPTABLE MANUFACTURER AND MODEL / QUALITY ASSURANCE:
- A. Acceptable manufacturer is Centrisys, or approved equal. Approval of an alternate shall follow process outlined in Article 11 of the Instructions to Bidders.
 - B. Centrifuge Manufacturer Qualifications:
 - 1. Centrifuge manufacturer must have at least 10 years of experience in the United States in the design, application, and supply of centrifuge systems.

2. All qualifying installations and references must be for centrifuge dewatering of municipal wastewater sludge at municipal wastewater treatment plants. Installations and references for dewatering industrial or drinking water sludge will not meet the requirements.
3. Centrifuge manufacturer must have a repair facility in North America that has the necessary equipment to rebuild bowl and scrolls and stocks Centrifuge spare parts.
4. An officer of the Company is required to certify the proposed alternate manufacturer has completely read the specification and takes no exception; or if exceptions are taken they must be listed in the alternate equipment proposal in accordance with Section 01 25 00.

C. Workmanship and Design:

1. The centrifuge manufacturing facility shall be ISO 9001:2015 certified.
2. All parts of the equipment provided to be designed and manufactured for long, continuous and uninterrupted service. All materials to be used are of best quality and entirely suitable for service required.
3. Provisions to be made for easy lubrication, adjustment or replacement of all serviceable parts. A minimum clearance of three feet around all sides of the equipment is required for proper maintenance.
4. Centrifuge assembly shall be designed to assure easy disassembly of the unit, including removal of the rotating assembly vertically, within the space and headroom provided.
5. The corresponding parts of multiple units if applicable shall be interchangeable.

1.08 WARRANTY:

- A. Warranty for the decanter centrifuge dewatering system and all associated equipment and appurtenances shall extend for 12 months after start-up.
- B. Warranty shall include all parts, labor, shipping, and coatings for repairing or replacing equipment that fails during the warranty period. Defects occurring within the warranty period shall be repaired or replaced by the manufacturer at no cost to the Owner.
- C. The Centrifuge manufacturer shall extend the standard warranty to include the items below:
 1. The Centrifuge manufacturer shall offer a 15 year warranty on the bowl center section, conical, and headwalls. This warranty will be in place as long as the customer has documented inspection and service compliance every 15,000 hours of operation and service conducted per the supplied O&M manual.
 2. As long as the decanter centrifuge is used for the applications it was designed for and operated, serviced, and maintained per documented manufacturer guidelines, the centrifuge manufacturer shall warrant mechanical centrifuge equipment (centrifuge frame housing and structural rotor components) to be free of manufacturing defects in material and workmanship for a period of FIVE years. Consumables, wear repairs, preventative service from normal use, and provided ancillary equipment is not covered in this extended warranty.

1.09 TESTING, MAINTENANCE AND SERVICE

A. Shop Test:

1. Upon completion of manufacture of centrifuge and appurtenances to be installed on this project, conduct shop tests which shall be performed and may be witnessed by the Engineer as outlined below:
 - a. Centrifuge:
 - a) Running test: Each machine, shall conduct a dry run for a minimum of 8 hours of continuous operation at proposed design operating speed.
 - b) Demonstrate that all equipment is capable of continuous operation in satisfactory manner without mechanical defects or operational difficulties. Measure and record vibrations and temperature of the main bearings.
 - c) If necessary, tests repeated until satisfactory results are obtained.
 - d) All defects or defective equipment revealed by or noted during tests to be corrected or replaced promptly at no additional compensation.

B. Services of Manufacturer's Representative:

1. Provide services of factory-trained Service Engineer, specifically trained on type of equipment specified. Submit qualifications of Service Engineer for approval. Man-day requirements listed are minimums, and do not relieve Contractor of obligation to provide sufficient service to place equipment in satisfactory operation.
 - a. Installation assistance: to assist in location of anchor bolts; setting, leveling, field erection, etc.; coordination of piping, electrical, miscellaneous utility connections: minimum 2 man-days.
 - b. Start-up, testing and calibration: minimum 2 man-days.
 - c. Operation and maintenance instruction: minimum 2 man-days.

C. Service Centers:

1. Centrifuge manufacturer must have at least two currently operating service centers located within the United States.
2. Centrifuge manufacturer must have at least two service technicians who are based at the United States service center, who has been trained specifically on the centrifuge system required for this project, and who would be available for a field service call at the WWTF within 48 hours of written notice.
3. Centrifuge manufacturer's service center must be capable of delivering spare parts, excluding bowls and scrolls, to the WWTF within 48 hours of notice.
4. Centrifuge manufacturer must prove they have a rotating assembly exchange program and a minimum inventory of 16 million in spare parts or require the manufacturer to provide more spare parts at bid time.
5. Scroll Replacement Services – In order to minimize downtime, the manufacturer shall offer the following:
 - a. Scroll exchange program. The scroll exchange program shall be established where an exchange scroll shall be shipped to the plant site for installation into the

centrifuge. The original scroll shall be subsequently shipped back to the North American repair facility for rework and be placed into the exchange program. Shop Drawing submittal must include a certified document by an officer of the company, providing at least three references pertaining to conveyer exchange program being used at an installation.

- b. Manufacturer shall submit documentation and references to demonstrate the ability to provide replacement scrolls/bowl assembly within 10 days from a minimum of two authorized Service Centers located in the United States.

1.10 DELIVERY, STORAGE AND HANDLING:

Items to be shipped as complete assemblies except where partial disassembly is required by transportation regulations or for protection of components. Equipment shall be delivered as completely assembled as practical to minimize field assembly. All equipment be pre-piped and pre-wired at the factory as much as practical. Contractor shall be responsible for unloading and any necessary field assembly. Contractor shall contact manufacturer for assembly requirements during bid.

1.11 SEQUENCING AND SCHEDULING:

Coordinate work with restrictions as specified in the Contract Documents. Dewater system sequencing will require temporary solids dewatering. See Section 01 01 00 Special Requirements and Section 01 89 00 Sequence and Limitations of Construction.

1.12 SPARE PARTS:

Special Tools: Provide standard manufacturer supplied toolbox with all tools needed to assemble and disassemble the decanter centrifuge dewater system, accessories, and appurtenances.

Spare Parts: System shall be supplied with all spare parts and items needed for 2 years of maintenance. This shall include belts, grease, oil, and any other part or item needed for maintaining the decanter centrifuge dewatering system. Spare parts shall be stored in labeled heavy duty or composite storage boxes.

- A. Spare parts shall include the following to be furnished with the centrifuges and back drive systems:

1. One (1) set - bearings and seals
2. One (1) set - o-rings and seals
3. One (1) set - matched drive belts
4. One (1) year supply of lubricants
5. One (1) year supply of filters
6. One (1) spare programmed memory card for PLC
8. One (1) pre-programmed memory card with backup copies of the program

- B. One set of the following tools shall be furnished

1. Set wrenches
2. Bowl lifter
3. Bearing puller

1.06 PRECONSTRUCTION AS-BUILT

Prior to construction Contractor shall obtain and provide to the manufacturer as-built information required for manufacturer design/selection/supply of the equipment and appurtenances specified herein to be installed at the location shown on the Drawings. Equipment shall be manufactured to accommodate existing conditions and for installation as shown, and shall include all required appurtenances, anchors, connections, and any other needed item for a complete and operational system sized for this specific installation and installed at the location shown in the Drawings. Any modifications required to existing structures, building, or other existing features shall be included in the amount bid.

2.00 PRODUCTS

2.01 GENERAL:

- A. The Equipment specified herein shall be furnished by sludge dewatering equipment manufacturer, who shall design and select the equipment for conformance to the design documents and as required for a fully operational decanter centrifuge dewatering system.
- B. Like items of equipment shall be the product of one manufacturer to achieve standardization of operation, spare parts, maintenance and manufacturer's service.
- C. Manufacturer's standard equipment sizes shall be used unless otherwise specified. The equipment provided shall be complete in all respects including, but not limited to, initial lubricants, components, calibration, alignment, and adjustments as necessary to place the equipment in operation to perform its intended functions.

2.02 MANUFACTURERS AND MODEL:

- A. The sludge dewatering equipment shall be manufactured by Centrisys Corporation. Acceptable models are CS 18-4 2PH and CS 14-2 2PH as indicated on the Bid Form.

2.03 CENTRIFUGE:

A. General:

- 1. The O-ring and seals shall be manufactured of the following:
 - a. O-ring: Viton
 - b. Lip Type Seals: Viton
- 2. All guards shall be constructed of powdercoated carbon steel

B. Centrifuge Assembly

- 1. Bowl:
 - a. The bowl shall consist of a horizontal cylindrical-conical assembly. The cylindrical and conical sections must be bolted together. One-piece bowls shall not be acceptable. Solids are discharged at the small end of the conical section. The bowl shall have a minimum diameter of 17.5 inches of I.D. and a minimum length of 68 inches with a minimum length: diameter ratio of 4:1 and maximum beach angle of 15 degrees. It shall be supported by roller bearings mounted in pillow blocks. Beach angles that are less or more than 15 degrees shall not be acceptable.

- b. Design to operate at a maximum of 3,000 Gs at the bowl wall for maximum process flexibility and reliability and to withstand all centrifugal forces encountered at design operating speed with adequate safety factors of at least 2.0. Inspect bowl for cracks, shrinkage, porosity, or other defects, by means of a liquid dye penetrant test.
- c. The G-volume of the centrifuge shall be a minimum of 100,000 when calculated at the maximum recommended operating speed.
- d. The bowl shall be centrifugally casted . All centrifugal castings shall be inspected for cracks, shrinkage, porosity or other defects, by means of liquid dye penetrate test. The centrifuge bowl shall be centrifugally cast from duplex stainless steel; with a minimum tensile strength of 100,000 PSI (690MPa) Material shall be A890 or 1.4470. Rolled, welded or Static cast bowls are not acceptable.
- e. The minimum acceptable thickness for the cylindrical and conical sections of the bowl wall shall be 0.7 inches to achieve a minimum safety factor of 2.0.
- f. The liquid pool depth in the bowl shall be adjustable through the use of weir plates at the large diameter end of the bowl where liquid is discharged. Solids shall be discharged from the small diameter end of the bowl. The plate dams shall be manufactured from 304 stainless steel.
- g. The bowl wall, both cylindrical and conical, shall be protected by longitudinal wear strips which cause formation of protective feed solids layer so that the solids slip on the scroll flights and adhere to the bowl wall for proper transportation. Machined grooves, that can cause accelerated wear, require conical machining or replacement when worn or Astro turf that often comes loose are not acceptable.
- h. The solids discharge ports shall be protected by specially designed raised inserts hard surfaced with tungsten carbide.
- i. Sludge feed shall be introduced into the centrifuge feed zone by means of a 2 inch diameter 304L stainless steel feed pipe from the solids end. The liquid end feed design is not acceptable. The feed shall be uniformly distributed into the centrifuge and the feed zone.

2. Scroll Conveyor

- a. The centrifuge shall include a horizontal cylindrical-conical scroll conveyor supported by grease lubricated cylindrical roller bearings and grease lubricated angular contact anti-thrust ball bearings and equipped with helical flights independently mounted concentrically within the centrifuge bowl. The conveyor hub shall be caste Duplex SS. All conveyers hub shall be inspected for cracks, shrinkage, porosity or other defects, by means of liquid dye penetrant test. Manufactured hubs are not acceptable.
- b. The scroll shaft shall be Duplex SS and flights shall be type 304SS
- c. Conveyor bearings shall be protected by specially designed anti-centrifugal seals or mechanical metal face seals with an elastomer spring element and shall be

manually lubricated by means of a manual grease lubrication system. O-ring seals are not acceptable for the conveyer bearings.

- d. The cylindrical section of the scroll conveyor shall be of the quasi axial flow design. Solid helical screw conveyors shall not be accepted.
- e. The scroll shall utilize a differential speed to convey solids from the cylindrical section to the conical section and out of the bowl with a minimum disturbance to the pool.
- f. The feed chamber should have a minimum of 9 feed ports which should cover an area no less than 90 in² to assure uniform introduction of feed into liquid pool with lowest velocity and therefore least disturbance of settled solids. The ports should be raised to minimize wear and shall be protected from abrasion by tungsten carbide coating and self-generated sludge liner. The feed nozzles or ports shall be protected by Tungsten carbide.
- g. The edge and face of the conveyor flights shall be protected against abrasion with Eutalloy hard surfacing material, from the feed zone to the liquid discharge end. The hard surfacing shall be guaranteed against failure for 15,000 hours of operation.
- h. The edge and face of the conveyor flights shall be protected against abrasion with TC tiles, from the feed zone to the solid discharge. The hard TC tiles shall be guaranteed against failure for 15,000 hours of operation.
- i. Centrifuge should be able to operate both leading and lagging for better operation and reduction of wear and longer life of bowl and scroll wear protection.

3. Casing:

- a. The centrifuge casing shall consist of a 304 stainless steel lower casing and a one piece upper casing. The purpose of the case shall be to contain and direct the solids and liquid discharge from the centrifuge, to act as a protective guard and to provide a complete enclosure for noise reduction. Stainless lined fiberglass or Fiberglass covers and guards not acceptable
- b. The lower casing shall be constructed with all process contact material of 304 stainless steel. The upper casing shall be manufactured of 304 stainless steel.
- c. Casing shall be a single piece to cover the entire rotating assembly and manufactured of stainless steel.
- d. A system will be provided as specified to limit the noise generated by the centrifuge to 88 dBA or less 1 meter from the centrifuge frame.
- e. The centrifuge case shall be vented as recommended by the manufacturer. Lifting hooks shall be provided for lifting the casing.
- f. To limit splashing and air leakage, the casing shall be provided with labyrinth seals where the bowl hubs intersect the casing and a gasket on the machine flanges where the upper and lower casings join.

4. Base:

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- a. The centrifuge shall be supported on a fabricated carbon steel base fusion bonded powder coat finish and 304 stainless steel wetted parts. The base shall be mounted on vibration isolators.
 - b. Machined surfaces shall be provided at all points where support loads are transferred to the base. The bottom portion of the base shall be provided with machined outlets for the attachment of the solids and centrate flexible connectors and chutes and other appurtenant connections.
 - c. Lifting hooks or solid lifting bars shall be provided for lifting the base.
5. Main Bearings:
- a. The main bearing shall be pillow block ball type. The bearings shall have an L-10 life of 100,000 hours minimum at 24 hours per day service.
 - b. The main bearings shall be lubricated by an automatic grease lubrication system.

C. MAIN DRIVE MOTOR:

The main drive motor shall be designed, manufactured and tested in accordance with the latest NEMA, IEEE and ANSI standards and have the following characteristics:

- | | |
|---------------------------------|---|
| 1. Type: | Squirrel-Cage, Single-Speed |
| 2. Max Horsepower: | 40 HP |
| 3. Synchronous Speed: | 3600 rpm |
| 4. Service Factor: | 1.15 |
| 5. NEMA Design: | B |
| 6. Insulation Class: | F or H |
| 7. Code Letter: | G |
| 8. Voltage: | 460 volts |
| 9. Phase: | 3-phase |
| 10. Ambient Temperature Rating: | 40 degrees C |
| 11. Maximum Temperature Rating: | 120 degrees C |
| 12. Mounting: | Horizontal |
| 13. Enclosure: | TEFC |
| 14. Duty Cycle: | Continuous |
| 15. Starting Method: | Reduced voltage |
| 16. Bearing Life: | 100,000 Hrs. as defined by
AFBMA B-10 Standards. |
| 17. Full Load | Not less than 94 percent |
| 18. Efficiency: | power factor of 0.88 |
| 19. Sound Level: | Maximum 85-89 dBA at 3 feet |

The motor shall be equipped with a VFD & thermal protection system to protect the motor from temperatures damaging the stator windings resulting from motor overload, frequent starting locked-rotor current.

- 1. A power use test must be performed and a penalty of \$4000 (present worth value) is to be paid to the Owner for every HP used above the specified HP.
- 2. Minimum size motors are required to be installed on the Centrifuge and if a larger Service must be installed, this will be paid to the Owner.

D. BACKDRIVE SYSTEM:

1. A Hydraulic Backdrive system shall be supplied with each centrifuge to provide speed variation between the conveyor and the bowl.
2. Hydraulic Backdrive System. The differential speed between the centrifuge bowl and scroll conveyor shall be produced by maximum 10 HP, water cooled hydraulic system which shall independently drive the scroll conveyor. The hydraulic scroll conveyor drive system shall be designed such that no mechanical gear reducer is required in the scroll conveyor drive train. The hydraulic drive system shall be capable of operating in either a manual or automatic mode. In the manual mode it shall provide for operation at a specific, adjustable scroll differential speed with internal torque allowed to vary up to the maximum allowable scroll shaft torque.
3. In the automatic mode it shall continuously monitor changes in internal torque created by variations in influent feed solids and automatically maintain a proper filling level by allowing the differential speed and torque to vary. The hydraulic drive shall operate in a manner such that, as the reactive torque of scroll shaft increases due to an increase in solids inventory in the bowl, the scroll differential speed shall gradually increase and, conversely, as the inventory of solids in the bowl and resultant reactive torque decreases, the scroll differential speed shall decrease. The net effect of this system, when operated in the automatic mode, shall be to maximize the time that cake solids are under the influence of accelerated gravitational force to ensure that the driest possible dewatered cake product is produced without plugging the centrifuge.
4. The system shall use a hydraulic pumping group and hydraulic motor. Torque-based adjustment shall be a function of input to the driven unit. The maximum torque input and rate of change of scroll differential speed shall be adjustable.
5. The system shall be designed such that automatic centrifuge shutdown is initiated in the event that excessive torque is detected. Two (2) sets of contacts shall be provided.
6. In the event that torque exceeds the normal operating range, the sludge feed pump shall be automatically stopped to allow the centrifuge to clear itself and shall automatically restart when the torque drops to the normal operating range. In the event that the torque approaches the limit of the drive, the second set of contacts shall automatically initiate shutdown of both the feed pump and centrifuge. In this instance manual reset of the alarm is required before the centrifuge can be restarted.
7. In case of a high torque shutdown, the backdrive should not trip but maintain full torque for the entire shutdown so that the machine clears itself while under reduced G-force, allowing the centrifuge to be clean when coming to a complete stop.
8. Backdrives should be designed such that if needed, they should be replaced without removing and dismantling the rotor.
9. No mechanical gear reducers such as planetary or cyclo gears are to be used in the scroll conveyor drive train.
10. Scroll drive system must be designed to offer cleaning capabilities while the centrifuge bowl is at a standstill.

11. Maximum torque and maximum differential speed shall be available with the bowl at a standstill.
12. After power failure, with machine fully loaded with solids, backdrive system must be capable of maintaining differential speed without accelerating the bowl.
13. Backdrive system shall be able to run the scroll only without input from the maindrive in plugged conditions. Systems with gear boxes shall require bowl locking devices

E. VIBRATION ISOLATORS:

1. The equipment manufacturer shall furnish vibration isolators which shall be capable of dampening vibration in all directions created during normal and emergency operation of the equipment. Spring-type isolators will not be accepted.
2. The vibration isolators shall be provided for the centrifuge assembly.

F. CONNECTIONS:

1. All piping and discharge chute connections to the centrifuge assembly, main drive motor and lubrication system, including but not limited to the feed sludge, wash water, polymer, drain, centrate, discharge sludge discharge and power and control connections, shall be equipped with flexible connections.
2. The flexible connections shall isolate the equipment from fixed rigid piping, chutes or other connections
3. The centrate discharge chute shall be rectangular with a top flange matching the flange of the flexible liquid discharge connection. The chute shall include a 2-inch connection as a vent flange.
4. The chute shall maintain the shape of the centrifuge casing discharge connection and shall be 12-inches long. The chute is to be manufactured from 304 stainless steel.
5. The dewatered sludge discharge chute shall be rectangular with a top flange which matches the flange of the solids flexible discharge connection. The chute is to maintain the shape of the centrifuge casing discharge connection and is to have sides as straight as possible to prevent solids from bridging or hanging up. The chute shall be manufactured of 304 stainless steel.

2.04 SLUDGE FEED PUMP:

A. MANUFACTURER:

1. Manufacturer: Netzsch. No others will be considered.
2. The centrifuge system, and all associated components including the sludge feed pump and conveyor shall be supplied by one manufacturer and delivered as a complete dewatering system.

B. DESCRIPTION:

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Sludge feed pump shall be sized/selected by the manufacturer for this specific installation as require for a fully operational decanter centrifuge dewatering system. Contractor/Manufacturer shall size the pump in accordance with the requirements herein and the Drawings and shall make any required site visits to acquire field information needed to size/select the pump to allow sludge feed to from the City's designated sludge storage tank(s) to the centrifuge system. Pump shall meet the following minimum requirements:

1. Furnish sludge feed pump with skid-mounted dewatering system
2. Designed to pump 2-5 percent aerobically digested sludge
3. Progressive cavity type
4. Variable speed operation, VFD controlled from centrifuge control enclosure
5. Capacity range: 50-100 gpm
6. Body: Case iron ASTM A48 class 35
7. Rotor: chrome plated
8. Stator: Rubber bonded to 316L steel tube with run dry protection
9. Base: Cast or fabricated steel
10. Seal: Mechanical
11. Speed reducing units: Gear driven, belt drives not permitted
12. Motor: Baldor TEFC 460V, 60 Hz, 3Ø, hp or manufacturers standard as required to deliver the flow rates specified.
13. Control: Feed pump control from PLC & VFD integrated into centrifuge control panel
14. Accessories: Shall come with all accessories required for installation in accordance the manufacturer's recommendations for this specific installation. To prevent damage through dry running the pump stator is to be provided with thermal dry running protection, including the control module for installation in the local control panel of the dewatering skid.
15. Surface preparation & Coating: All surfaces shall be prepared and shop painted with the manufacturer's standard system.

2.05 DEWATERING SOLIDS CONVEYOR AND CUSTOM DISCHARGE BOX:

A. SOLIDS CONVEYOR:

Solids conveyor shall be sized/selected by the manufacturer for this specific installation as require for a fully operational decanter centrifuge dewatering system that discharges solids into the existing solids conveyor system receiving box. Contractor/Manufacturer shall size and select the solids conveyor in accordance with the centrifuge system requirements, the requirements herein

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and the Drawings, and shall make any required site visits to acquire field information needed to size/select the conveyor. Solids conveyor shall meet the following minimum requirements:

1. Furnish screw conveyor system with stand-mounted dewatering system which should include a fixed conveyor beneath the centrifuge. The fixed conveyor beneath the machine shall be designed to operate as required for diversion of liquid during startup of unit with control through the centrifuge PLC.
2. Controls for the existing solids conveyor system shall be tied to the new conveyor system and both conveyors tied into the new PLC and centrifuge system controls. System shall be designed to operate as single conveyor system for the decanter centrifuge dewatering system and shall discharge solids into the back of the City's dump truck. All electrical, controls, appurtenances, stands, fabricated metal receiving boxes, accessories, etc. and any other item needed for a complete and operational solids conveyor system shall be included in the amount bid.
3. Shaftless Conveyor shall be fixed below centrifuge to collect solids from the centrifuge and shall be installed with a reversing starter that is controlled by centrifuge torque to allow direction change during startup for handling of wet material during startup and flushing.
4. Conveyor height, length, angle, etc. shall be selected by the manufacturer to meet the constraints of the existing building (see Drawings) and as required to discharge solids into the existing solids conveyor receiving box.
5. Minimum capacity 1500 pounds per hour
6. Trough and chute: Stainless steel, 1/8 inch thick minimum
7. Trough cover: Stainless steel, 12 gage minimum
8. Spiral flights: 9" Diameter carbon steel, 1" thick.
9. Wear liner: Ultra high-molecular weight polyethylene, 3/8 inch minimum thickness
10. Fasteners: Type stainless steel
11. Drive shaft: AISI 1045
12. Conveyor Drives: Fixed conveyor shall be a 3Hp TEFC, 460V, 3Ø, 60 Hz constant speed motor with gear box running at 30 rpm. Outboard discharge conveyor shall be a 3Hp TEFC, 460V, 3Ø, 60 Hz constant speed motor with gear box running at 30 rpm.
13. Shaft: Minimum 2 inch diameter welded to spiral with sealed housing
14. Trough to be equipped with filling chute at loading end
15. Provide discharge chute
16. Solids conveyor controls: Provide hand/off/automatic switch within NEMA 4X centrifuge control panel OIT and integrated with centrifuge PLC

17. Furnish conveyor with motion failure alarm connected to PLC with run confirmation signal displayed on centrifuge control panel
18. Conveyor manufacturers: KWS or approved equal

B. CUSTOM DISCHARGE BOX:

A custom discharge box shall be fabricated by the solids conveyor manufacturer from stainless steel with thickness to match existing solids conveyor receiving box thickness. Discharge box shall tie the new conveyor system to the existing conveyor system and shall prevent solids from leaving the chute in transition from new to existing conveyor. Provide/install Discharge box dimensions including exact discharge location shall be coordinated and selected by the Contractor/manufacturer based on clear space requirements (see Drawings) and actual building dimensions, decanter centrifuge system dimensions, frame dimensions, and solids conveyor dimension to be used.

2.06 POLYMER FEED SYSTEM:

A. MANUFACTURER

1. Manufacturer: Velodyne.

B. DESCRIPTION

1. The polymer activation and feed system shall be capable of effectively activating and fully blending with water a homogenous polymer solution as needed for the decanter centrifuge dewatering system. Polymer system shall be sized/selected/supplied by the centrifuge manufacturer for this specific installation, and shall meet the minimum requirements herein.
2. The polymer feed system shall include all equipment, appurtenances, accessories, etc. required for a fully operational system, and as required for operation of the centrifuge system. Polymer shall be selected by the manufacturer for this specific installation and shall be included in the amount bid.

C. MIXING CHAMBER

1. The polymer mixing chamber shall have a confined inversion zone wherein the oil phase continuous emulsion is injected, stripping the oil from the polymer molecules, partially hydrating the solution. The solution then passes from the confined space without recirculation through that confined space to the activation zone consisting of a minimum of three baffled zones creating a plug flow for the solution exposing it to mild turbulence with low shear to complete the hydration process. There shall be no recirculation of the initially inverted neat polymer.
2. The system shall have a minimum of two mixing zones designed to strip the oil from the emulsion and allow hydration of the polymer molecule without damaging the polymer's molecular structure, regardless of flow rate.
3. The systems mixing energy shall be variable in intensity. Mixing energy must be variable by VFD control to handle the wide range of polymers available. Mixer motor shall be

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wash down duty, 0.5 hp, TEFC, 3450 rpm, 56C frame for polymer solution flow rates up to 40 gpm.

4. The mixing chamber shall include a flushing provision for the mechanical seal utilizing incoming water flow to continuously flush the seal area when in operation. A secondary lip seal shall be installed between the mixing chamber mechanical seal and the mixer motor. A weep hole shall be located between the mechanical seal and lip seal to provide additional protection for the mixer motor in the event of a mechanical seal failure. The system shall also be equipped with a seal failure detection system to indicate an alarm on the control panel when the seal fails.
5. Provide a neat polymer check valve specifically designed to isolate neat polymer from dilution water. The valve shall be designed with an open, unobstructed path to the valve seat. The valve body shall be constructed of Stainless Steel with viton seals. The plug and spring shall be stainless steel. The spring shall be located outside the mixing chamber for simple adjustment. The valve shall be readily accessible for cleaning, shall be easily disassembled and reassembled and shall not require tools for removal, cleaning or replacement.

D. DILUTION WATER ASSEMBLY

1. A 1" FNPT 304 stainless steel dilution water inlet connection shall be provided to allow a maximum total flow of 300 gpm.
2. The dilution water flow rate shall be monitored by a Rotameter type flow meter having a range of 30 to 4,000 GPH. A union shall be provided on the Rotameter to allow easy removal for cleaning.
3. Unit shall have an electric solenoid valve with Nema 4 rated coil for on/off control of total dilution water flow.
4. A thermal flow switch shall be provided and mounted in the dilution water line. The switch shall be rated NEMA 4X and manufactured by IFM or equal.
5. Provide a 2-1/2" stainless steel liquid filled pressure gauge to monitor dilution water inlet pressure.

E. POLYMER METERING PUMP

1. The unit shall have a neat polymer metering pump integrally mounted on the systems skid. The metering pump(s) shall have a range of 0.1 to 10 GPH of neat polymer. The pump shall be a solenoid driven, diaphragm type metering pump. Controls to include provision for stroke rate adjustment and manual stroke length knob.
2. Provide a calibration column with two full port PVC ball valves having Viton o-rings. The column shall be calibrated for a one minute draw-down and read in GPH and milliliters.
3. Provide a metering pump priming assembly including vacuum device and valve.

F. SOLUTION DISCHARGE ASSEMBLY

1. A 304 stainless steel solution discharge connection shall be provided.
2. Provide a 2-1/2” stainless steel liquid filled pressure gauge to monitor system discharge pressure.
3. A check valve of PVC construction with union shall be installed integral to the system to prevent backflow of polymer solution or process water, sludge, etc. into the mixing chamber or dilution water piping.

G. POLMER SYSTEM CONTROLS

1. A control panel integral to the systems frame shall be provided. The enclosure shall be rated NEMA 4X and constructed of FRP. The control panel shall consist of all digital displays, potentiometers, switches, lights, relays, and other control devices required for a complete operable system. The control panel and all components shall be industrial duty. All skid mounted electrical components interconnected to the control panel shall terminate at numbered and labeled terminal blocks. The terminal blocks shall be sized for 14 ga. wire. Wires shall be neatly run through wire race-way and numbered with adhesive type labels. The control panel shall be built and labeled according to UL 508A standards. Systems without a UL labeled panel will not be acceptable. Control features shall include the following:
 - a. Control Devices:
 - 1) System ON-OFF-REMOTE switch. In remote mode the system shall start by remote dry contacts.
 - 2) An adjustable flush timer shall be supplied to allow dilution water to flush the mixing chamber and discharge piping after automatic shutdown.
 - 3) INT/EXT (internal / external) switch located on the metering pump. In INT mode the metering pump shall be controlled by a stroke length and stroke frequency knobs on metering pump. In EXT mode the metering pump shall respond to a 4-20mA pacing signal.
 - b. Indicators:
 - 1) Main Power On
 - 2) LCD Display of metering pump output (located on metering pump)
 - 3) Loss of water flow alarm
 - 4) Seal Failure Alarm
 - c. Alarms:
 - 1) Thermal flow switch. Switch rated NEMA 4X. Metering pump goes to stand-by mode when loss of water flow occurs. The pump restarts when the alarm is acknowledged and flow returns to an operating state.
 - d. Inputs:
 - 1) Remote Start / Stop dry contact
 - 2) Pacing Signal based on process flow (4-20mA)
 - e. Outputs:
 - 1) System Running (dry contact)
 - 2) System in “Remote Mode” (dry contact)
 - 3) Loss of water flow (dry contact)
 - f. Voltage:

- 1) 120 VAC / 1 phase / 60 Hz

H. POLYMER EQUIPMENT SKID

The system's frame shall be of rugged 304 stainless steel construction. No mild steel shall be used. All piping shall be rigidly supported.

2.07 CONTROLS

1. Controls system shall meet the requirements of Division 26 and requirements herein.
2. Control system shall be manufactured by the centrifuge manufacturer and shall include all items required for a fully operational system tied into the treatment plants SCADA system.
3. The control panel or motor control cabinet shall be a stainless steel NEMA 4X enclosure. Included with the enclosure shall be:
 - a. Main circuit breaker,
 - b. Control power transformer,
 - c. Variable frequency drive to run the centrifuge main bowl motor,
 - d. Scroll drive motor starter and proportional valve amplifier
 - e. Variable frequency drive system for any sludge pumps provided
 - f. Polymer control circuits
 - g. Allan Bradley Compactlogix PLC
 - h. Panelview Plus 7 standard edition 10" touchscreen
4. Through the interface, the operator shall be capable of verifying sludge and polymer actual flow rates from flow meters. The control panel shall be provided with centrifuge feed pump start/stop speed control; polymer feed pump start/stop speed control, Backdrive start/stop control and a cake conveyor start/stop control. Also included shall be bowl drive amp feedback and elapsed time. Pilot lights, pushbuttons, scroll drive starter and alarm system shall be mounted in the door. A PanelView Plus 1000 OIT shall be provided.
5. All the controls for a new or existing polymer system shall be incorporated into this panel.
6. All the controls for the existing solids conveyor shall be incorporated into this panel.
7. All components in the control panel shall be completely factory wired. All external control connection points shall terminate on a terminal strip with a minimum of 10% spare terminal connections supplied. All pushbuttons and pilot lights shall be watertight, corrosion resistant and in accordance with current plant standards.
8. Auxiliary system operation shall be controlled automatically upon starting a centrifuge or manually with individual pushbuttons. Control logic shall be CompactLogix PLC based with ladder logic programming. The system shall provide separate contact outputs for remote indication of centrifuge running. The controls for the feed system will be intergraded into the panel and interlocked. The feed system shall be interlocked against low level, high-pressure low pressure and low polymer.
9. The PLC shall be as manufactured by Allan Bradley.

10. Centrifuge electrical/control system shall include all equipment and appurtenances needed to power, control and integrate the existing sludge conveyors and existing booster pump (if deemed necessary by the manufacturer) into the centrifuge system. Centrifuge control panel shall contain circuit breakers, motor starters, control wiring, etc. and any other items, equipment, or appurtenances required for integration of the existing sludge conveyor an booster pump into the centrifuge electrical/control system and operation of it integral with the centrifuge system.

2.08 MONITORING SYSTEM

- A. Monitoring system shall include the following:

1. The minimum inputs and shutdown Alarm indications shall be the following:
2. Excessive vibration
3. Excessive main drive motor overload
4. Excessive Backdrive drive motor overload
5. Backdrive drive malfunction
6. Main Drive malfunction
7. High-high scroll conveyor torque
8. Centrifuge bowl overspeed
9. E-Stop
10. High-high vibration
11. High-high bearing temperature
12. Control Panel high temperature
13. Lubrication Fault
14. The following trouble inputs and indications shall be available at the PLC, but not shut down the centrifuge:
15. Feed pump fault
16. Polymer system fault
17. Low flow-feed /polymer
18. High scroll conveyor torque
19. High vibration
20. The following inputs and shutdown Alarm indications can be available for optional equipment at the PLC:
21. Main drive motor temperature
22. Back drive motor temperature
23. Hydraulic cooling Fan aux fault
24. Other options equipment
25. The following trouble inputs and indications can be available for optional equipment at the PLC, but not shut down the centrifuge:
 - a. Diverter
 - b. Discharge conveyors (new and exsiting)
 - c. Sludge / polymer pump

- B. All the centrifuge system manufacturers standard instrumentation, telemetry, controls shall be implemented in the system controls.

2.09 PAINTING

- A. Shop and field painting to be manufacturers standard except where indicated otherwise in specifications

B. Do not paint the 304SS skid members

2.10 CENTRIFUGE FRAME SYSTEM

A. A steel frame system shall be designed by the Centrifuge manufacturer as shown on the Drawings, and meeting the following requirements:

1. Frame system shall be designed by the manufacturer including final location, dimensions, and configuration of the system to allow for a fully operational system and clear space requirements shown on the drawings.
2. Manufacturer/Contractor shall obtain all field investigations and all as-built information needed to design the frame system within the existing building.
3. A shop drawing of the frame system including as-built dimensions, clear space, and building improvements (if needed) shall be provide to the Owner during the submittal process.
4. Structural design of the frame shall be completed by the manufacturer and shall include:
 - a. Structural design of the system
 - b. Mounting of centrifuge as shown on the Drawings, and as required for an operational system within the existing building.
 - c. Mono-rail system including manual hoist and ability to remove drive assembly
 - d. Centrifuge system vibration
 - e. Design of anchors to the existing building floor and building improvements (if needed)
5. Frame shall provide access to the centrifuge for maintenance. Minimum access shown on the Drawings.
6. If frame system is larger than the existing access openings, the frame system shall allow for disassembly and reassembly as needed to fit within existing openings.

3.00 PART 3 - EXECUTION

3.01 FACTORY TEST:

- A. Manufacturer shall conduct in-factory functional testing of assembled unit
- B. Manufacturer shall submit protocol for factory test for owner review.
- C. Manufacturer to submit factory test results report for review by Owner prior to shipment of the assembled unit to the jobsite.
- D. Test shall include the following at the minimum.
 1. Power skid unit with 480VAC, 60Hz, 3 phase power
 2. Test rotation of all motors and drive units
 3. Simulate operation conditions and modes to confirm function

4. Simulate all alarm input conditions to verify appropriate alarm indication and shutdown functions
- E. Witnessed Testing:
1. Manufacturer to provide four weeks advance notice to Owner of factory test.
 2. Manufacturer shall allow Owner, at Owners option and cost, to visit suppliers factory test.
- 3.02 DELIVERY OF EQUIPMENT:
- A. Contractor shall coordinate work herein with construction sequencing and phasing requirements included in the Contract Documents.
 - B. Equipment supplied under this section not to be delivered to the site until construction has progressed to the point where installation may properly commence.
 - C. All equipment shall be protected and shall be in accordance with the Manufacturer's recommendations.
 - D. Contractor shall replace any equipment damaged after receipt of equipment at no cost to the Owner.
- 3.03 INSTALLATION:
- A. Installation shall be in strict accordance with the Manufacturer's recommendations and instructions and shall be in accordance with the specifications herein and the Drawings. Installation shall include all equipment, labor, materials, connections, or any other item needed for a complete and operational Decanter Centrifuge Dewatering System.
 - B. All equipment, components, piping and appurtenances shall be installed true to alignment and rigidly supported. Any damage caused by the negligence of the Contractor to the above items shall be repaired or replaced by the Contractor to its original condition.
 - C. Interconnecting piping supplied by the Contractor to be hydrostatically tested by the Contractor.
 - D. The centrifuge system Manufacturer's representative to be present during placement and connection of the unit to power and liquid connections to instruct and observe installation.
 - E. The centrifuge Manufacturer's representative to inspect the installation prior to startup in order to verify that the equipment has been properly installed.
 - F. The centrifuge system Manufacturer's representative shall calibrate the equipment with the Owner's operator present after installation prior to startup.
 - G. All products, accessories, and appurtenances shall be installed in accordance with manufacturer's instructions and approved submittals.
 - H. The Contractor shall provide all hardware and accessories required for installation.
 - I. Anchor bolts are to be sized by Manufacturer and provided by Contractor.

3.04 MANUFACTURER’S ASSISTANCE:

- A. Manufacturer shall provide installation instruction manuals for Contractor’s assistance at least 30 days prior to shipment of factory assembled treatment units
- B. Manufacturer shall provide assistance regarding handling, assembly and installation requirements for complete installation by the Contractor.
- C. Manufacturer shall provide assistance as needed for for construction of the Decanter Centrifuge Dewatering System.
- D. Contractor shall verify all equipment is installed in accordance with the manufacturer’s recommendations and literature and the Drawings.

3.05 FIELD QUALITY CONTROL

A. Service:

- 1. Qualified service personnel must be available on a 24 hours a day basis
- 2. The personnel must be completely familiar with the items supplied so as to return inoperative equipment to service in the shortest possible time
- 3. The pre-qualification information is to include the following:
 - a. Name, educational background and years of service experience for all service personnel

B. Tests:

- 1. Field testing and checking of installation to be approved by Manufacturer’s field representative
- 2. Test under full load conditions
- 3. Verify that all control system functions, including alarms, perform as specified
- 4. Any spare parts furnished as specified but used during startup must be replaced prior to final acceptance
- 5. Manufacturers field representative to perform field test
- 6. An independent lab is required to test all samples and the Centrifuge Company is to pay for this while the Owner selects the lab.
- 7. If equipment fails to meet performance specifications, the manufacturer, at no cost to the owner, shall modify, replace, and otherwise do whatever is necessary to provide equipment that will pass the equipment testing specification.

C. Manufacturers Field Services:

- 1. Qualified factory-trained representative to provide startup and operator training services. Representative to be available within two (2) weeks of request for services. Representative to provide following services:
 - a. Equipment installation review and certification of proper installation: Provide one (1) trip; minimum of eight (8) hours onsite for initial visit to checkout installation and verify that centrifuge system is ready to operate
 - b. Startup and operator training: Provide one (1) trip of minimum two (2), 8-hour days to provide classroom training of operating personnel in the operation of centrifuge system and to provide “hands-on” training for operation of equipment

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- c. Six (6) month performance review and post startup training: One (1) trip of 8-hours minimum to make operating adjustments and provide additional instruction to Owners personnel within 6 months after final acceptance of equipment

4.00 MEASUREMENT AND PAYMENT

4.01 GENERAL:

- A. See Section 01 22 00 – Measurement and Payment for General Requirements. See Section 01 01 00 – Special Requirements/Bid Items for possible modifications to Standard Bid Items.
- B. If no specific bid item is provided, measurement and payment shall be considered incidental and shall be included in the bid price for other items of work for the project.

4.02 BID ITEMS:

A. Decanter Centrifuge Dewater System

1. Included shall be designing, furnishing and installing the decanter centrifuge dewater system and appurtenances. Centrifuge Model shall be Centrisys CS 18-2 2PH or approved equal. Payment shall be limited to 80% until the equipment has passed all acceptance testing requirements and O&M manuals have been submitted and approved.
2. Payment shall be on a Lump Sum (L.S.) basis.

B. Decanter Centrifuge Dewater System (Reduced Capacity)

1. Included shall be designing, furnishing and installing the decanter centrifuge dewater system and appurtenances. Centrifuge Model shall be Centrisys CS 14-4 2PH or approved equal. Payment shall be limited to 80% until the equipment has passed all acceptance testing requirements and O&M manuals have been submitted and approved.
2. Payment shall be on a Lump Sum (L.S.) basis.

****END OF SECTION****